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SAFETY ASSESSMENT OF PLANT RAW MATERIALS CROCUS ALATAVICUS

Resume. *This article presents the results of a safety assessment of the plant material Crocus alatavicus. The following contents were determined: heavy metals and arsenic, radionuclides (strontium-90 and cesium-137), the residual amount of pesticides, the indicator is microbiological purity.*
Key words: *Crocus alatavicus, the safety of plant materials, radionuclides, heavy metals, pesticides, microbiological purity, medicinal plant materials.*

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CROCUS ALATAVICUS ӨСІМДІК ШИКІЗАТЫНЫҢ ҚАУІПСІЗДІГІН БАҒАЛАУ

Түйін. Бұл мақалада Crocus alatavicus өсімдік шикізатының қауіпсіздігін бағалау нәтижелері келтірілген. Өсімдік шикізатының құрамындағы ауыр металдар мен мышьяк, радионуклидтер (Стронций-90 және цезий-137), пестицидтердің қалдық мөлшері және микробиологиялық тазалық көрсеткіші анықталды.
Түйінді сөздер: Crocus alatavicus, өсімдік шикізатының қауіпсіздігі, радионуклидтер, ауыр металдар, пестицидтер, микробиологиялық тазалық, дәрілік өсімдік шикізаты.

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ОЦЕНКА БЕЗОПАСНОСТИ РАСТИТЕЛЬНОГО СЫРЬЯ CROCUS ALATAVICUS

Резюме. В данной статье приведены результаты оценки безопасности растительного сырья Crocus alatavicus. Определены содержания: тяжелых металлов и мышьяка, радионуклидов (стронция-90 и цезия-137), остаточное количество пестицидов, показатель – микробиологическая чистота.
Ключевые слова: Crocus alatavicus, безопасность растительного сырья, радионуклиды, тяжелые металлы, пестициды, микробиологическая чистота, лекарственное растительное сырье.

Introduction. Low toxicity with a sufficiently high efficiency, a wide range of therapeutic action, a minimum of side effects, as well as a relatively low cost allow medicinal plant materials (MPM) and preparations based on them to occupy a stable position in the pharmaceutical market. Currently, a significant proportion of consumers of herbal medicines is occupied by the perfumery, cosmetics and food industries. This contributes to the increasing demand for herbal medicines [1].

The growth of industry leads to an increase in the anthropogenic load, which negatively affects the state of plant objects. Test sites, which are the sources of radiation contamination of the territory of our country, have a negative impact on the soil cover. Enterprises of the oil and gas complex and non-ferrous metallurgy of the republic are among the leaders in soil pollution with various chemical compounds, including heavy metals. A significant role in the land pollution of cities and other settlements belongs to motor transport, the number of which has increased significantly in recent years. The use of pesticides during various types of agricultural treatment of seeds and plants can also lead to soil contamination and accumulate in medicinal herbal remedies [2-4].

The above anthropogenic factors necessitate quality control of medicinal products, taking into account traditional pharmacopoeial indicators.

The guiding principle of quality assessment in relation to the safety of medicinal plant materials is the regulation of the content of residual contaminants, including heavy metals, arsenic, radionuclides, pesticides and the number of microorganisms.

In order to systematically ensure the appropriate quality of medicinal plants and the raw materials and substances obtained from them, proper principles for the cultiva-

tion and preparation of medicinal plants have been introduced. In the case of herbal preparations, the production and primary processing of raw materials directly affect the content and quality of biologically active substances (BAS). Due to the complexity of biologically active substances and the limited possibilities of analytical methods for their complete characterization, the provision of the required level of quality is required already at the stage of collection, cultivation, harvesting and primary processing of medicinal plant materials.

Therefore, to solve all these problems, the World Health Organization developed in 2003 guidelines on good principles (methods) for the cultivation and harvesting of medicinal plants (GACP). We have developed a method for cultivating Crocus alatavicus from seeds in accordance with the principles of GACP [5, 6].

The purpose of this work is to evaluate the safety parameters of Crocus alatavicus Regel & Semen of the Iridaceae family.

Materials and methods. Materials and methods. The object of the study is the dried whole raw materials of Crocus alatavicus, collected during the flowering period. The analyses were carried out according to pharmacopoeia methods.

Experimental part Heavy metals and arsenic. Determination of heavy metals and arsenic was carried out in accordance with the State Pharmacopoeia of the Republic of Kazakhstan (SPh RK I), vol.1, 2.4.8 and 2.4.2 – "Heavy metals" and "Arsenic" in medicinal plant raw materials and medicinal plant preparations by atomic absorption spectrometry (SPh RK I, vol.1, 2.2.23) [7].

Pesticides. According to the general monograph "Medic-

Table 1 - Determination of compliance of heavy metals and arsenic in raw materials with acceptable

Identification of the sample	The name of the determined indicator	LOQ, mcg/kg	Фактическое значение, mcg/kg
Crocus alatavicus Regel & Semen	Cadmium	1,0	not detected
	Lead	6,0	0,1164
	Mercury	0,1	not detected
	Arsenic	0,5	not detected

Table 2 - Determination of the compliance of the content of residual pesticides in raw materials with acceptable standards

Identification of the sample	Name of the indicator to be determined	Pesticide residue limit, mg/kg	Actual value, μg/kg
Crocus alatavicus Regel & Semen	α - HCCH β - HCCH	HCCH isomers (except γ): в total not more than 0.1 (SPh RF) total no more than 0.3 (EPh)	 not detected not detected
	γ - HCCH	not more than 0.1 (EPh)	0,00215
	DDE, r, r. DDT, r, r.	total not more than 0.1 (SPh RF) total not more than 0.6 (EPh)	0,00262 0,00284
	Aldrin	not allowed (SPh RF) not more than 0.05 (EPh)	not detected

Table 3 - Contents of strontium-90 and cesium-137 in plant raw material C.alatavicus

Names of indicators	ND for test methods	ND requirements	Actual results (Bq/kg)	Temperature ^{0}C, humidity	Note
Content of strontium-90, Bq/kg	MVI № KZ 07.00.00303-2019	Up to 200	0,92	20,8^{0}C 72%	Up ± 3,25
Cesium-137 content, Bq/kg	MVI № KZ 07.00.00304-2019	Up to 400	8,65	20,8^{0}C 72%	Up ± 6,75
Note: Up is the expanded uncertainty					

Table 4 - Microbiological purity of plant raw materials C.alatavicus

Names of indicators	ND for test methods	ND requirements	Actual results
Total number of viable aerobic microorganisms, CFU/g	SPh RK I, v. 1, p. 176	Not more than 10^7	8,6x10^5
Fungus, CFU/g	SPh RK I, v. 1, p. 176	Not more than 10^5	2x10^2
E. coli in 1.0 g	SPh RK I, v. 1, p. 181	Not more than 10^2	less than 10

inal plant materials (MPM)" - of the SPh RK I, vol.3, p. 144-146, MPM must pass the pesticide residue test. The test was carried out in accordance with General pharmacopoeia article (GPhA) 1.5.3.0011.15 "Determination of the content of residual pesticides in medicinal plant materials and herbal medicinal products by gas chromatography" (State Pharmacopoeia of the Russian Federation (SPh RF), XIV edition, vol. 2. – Moscow, 2018. - 1449 p).
Radionuclides. According to the general monograph "Medicinal plant materials" - SPh RK I, vol.3, p. 144-146 it is mandatory to determine radionuclides in plant materials. Determination of the specific activity of Sr-90 and Cs-137 in herbal medicines was carried out in accordance with the requirements of the GPhA 1.5.3.0001.15 "Determination of the content of radionuclides in herbal medicines and medicinal plant preparations" (SPh RF, XIV edition, vol. 2. - Moscow, 2018. - 1449 p.).
Microbiological purity. In the microbiological analysis of herbal medicines, quantitative determination of aerobic microorganisms, yeasts and moulds is carried out, as well as the isolation of certain types of pathogenic bacteria. According to article PhEAEU I, vol.1, 2.3.1.4 "Requirements for the microbiological purity of pharmaceutical substances of plant origin, herbal medicinal products and extracts used for their production, a limited number of microorganisms is allowed in medicinal products in the absence of certain species, dangerous to human health". The analysis was carried out in accordance with the GPhA 2.6.12 and 2.6.13 of the SPh RK I, vol.1 [8, 9].

Results and their discussion. Heavy metals and arsenic. The maximum allowable content of heavy metals and arsenic should not exceed the values given in the normative documents. The determination of the compliance of heavy metals and arsenic in raw materials with acceptable standards is shown in Table 1.
The study results showed that in the test sample, Cd, Hg and As were below the limit of quantitation (LOQ), and the Pb content was 0.1164 μg/kg. Pesticides. The results of the GC-MS analysis showed that the content of α and β isomers of HCCH is below the value of the limits for the permissible content of residual pesticides, including γ-HCCH is 0.00215 μg/kg. Traces of pesticides 4,4-DDT and 4,4-DDE amounting to 0.00546 μg/kg were found. According to the SPh RF, the content of aldrin in herb medicines is not allowed, and according to the European Pharmacopoeia (EPh), the content of residual aldrin is not more than 0.05 μg/kg. The research results show the absence of this pesticide [10, 11].
The traces of the content of residual pesticides were compared with the values of the limits of the residual pesticides permissible content (APSOP), given in the SPh RF and the EPh. The comparison results are shown in Table 2.
The results of studies of medicinal plant materials showed the practical absence of organochlorine pesticides in the analyzed material. Radionuclides. It has been experimentally established that the plant raw materials C.alatavicus are environmentally safe for such ecotoxicants as radionuclides. The results showed the content of strontium-90 and cesium-137 in the studied plant within acceptable limits (Table 3).
Microorganisms. The standards recommended by the Pharmacopoeia of the Republic of Kazakhstan were used to assess the quality in terms of microbiological purity. Table 4 shows the results of determining the microbiological purity of the studied plant.

Conclusion. Thus, to establish the safety of the C.alatavicus raw materials, we studied the content of heavy metals, radionuclides, residual pesticides, as well as the microbiological purity of the raw material. The content of all indicators corresponds to acceptable standards. It has been established that the studied plant raw material C.alatavicus complies with the requirements of regulatory documents in terms of environmental safety. We believe that the use of cultivated plant materials as a phytosubstance has a positive effect on the quality of the finished product.

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