Производственные и обрабатывающие отрасли

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STUDY OF THE CONTENT OF TOXICANTS IN FISH ORGANS AND TISSUES

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An ecological assessment of the content of antimony and arsenic in the organs and tissues of fish caught from the Zarafshan River is given. The relevance of the determination of toxic elements is assessed, despite the fact that their content in fish meat is negligible and requires the use of highly sensitive physicochemical methods for determination. The possibility of using the proposed method for determining toxic elements in diagnostics and in the environmental assessment of the region under study, as well as processing these fish for canned food, is shown. The method and materials for sampling fish according to GOST 26929 ``Raw materials and food products'' are presented. The method of atomic absorption detection of toxic elements was used on Spectr-1 and Saturn instruments equipped with electrothermal atomizers, with the help of which elements were determined in the form of hydrides and in aqueous solutions. Hydrides are fed into the furnace through a jet, and aqueous solutions are introduced using a microdoser. Quantitative determination of toxic elements was carried out by a calibrated (graded) graphical method. The danger of the presence of arsenic and antimony in the meat of fish selected for the experiment: marinka, carp and silver carp was assessed.

Keywords: ecological assessment, toxic elements, antimony content, arsenic, fish organs, tissues, maximum allowable concentration, human health.

ТОКСИКАНТТАРДЫҢ МАЗМҰНЫН ЗЕРТТЕУ БАЛЫҚТЫҢ МҮШЕЛЕРІНДЕГІ МЕН ҰЛЫНЫНДА

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Зарафшан өзенінен ауланған балықтардың ағзалары мен ұлпаларындағы сурьма мен мышьяк құрамының экологиялық бағасы берілген. Уытты элементтерді анықтаудың өзектілігі олардың балық етіндегі мөлшері шамалы және анықтау үшін жоғары сезімтал физика-химиялық әдістерді қолдануды талап ететініне қарамастан бағаланады. Ұсынылған әдісті диагностикада және зерттелетін аймақтың экологиялық бағалауында улы элементтерді анықтауда, сондай-ақ осы балықты консервілерге өңдеуде қолдану мүмкіндігі көрсетілген. ГОСТ 26929 «Шикізат және тамақ өнімдері» бойынша балық сынамаларын алу әдісі мен материалдары ұсынылған. Улы элементтерді атомдық абсорбциялық анықтау әдісі электротермиялық тозаңдатқыштармен жабдықталған Spectr-1 және Saturn аспаптарында қолданылды, олардың көмегімен элементтер гидридтер түрінде және сулы ерітінділерде анықталды. Гидридтер ағын арқылы пешке беріледі, ал су ерітінділері микродозер арқылы енгізіледі. Уытты элементтерді сандық анықтау калибрленген (разрядты) графикалық әдіспен жүргізілді. Тәжірибе үшін іріктеліп алынған балық: маринка, тұқы және күміс тұқы балықтарының етінде мышьяк пен сурьманың болу қаупі бағаланды.

Түйінді сөздер: қоршаған ортаны бағалау, улы элементтер, сурьма құрамы, мышьяк, мүшелер, балық ұлпалары, шекті рұқсат етілген концентрация, адам денсаулығы.

ИССЛЕДОВАНИЕ СОДЕРЖАНИЯ ТОКСИКАНТОВ В ОРГАНАХ И ТКАНЯХ РЫБ

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Дана экологическая оценка содержания сурьмы и мышьяка в органах и тканях рыб, выловленных из реки Зарафшан. Оценена актуальность определения токсичных элементов, несмотря на то, что их содержание в мясе рыбы ничтожно мало и требует использование высокочувствительных физико-химических методов определения. Показана возможность использования предлагаемого метода определения токсичных элементов в диагностике и в экологической оценке исследуемого региона, а также переработки этих рыб на консервы. Приведены метод и материалы по отбору проб рыб по ГОСТ 26929 ``Сырье и продукты пищевые''. Использован метод атомно-абсорбционного обнаружения токсичных элементов» на приборах «Спектр-1» и «Сатурн», снабженных электротермическими атомизаторами, с помощью которых определены элементы в виде гидридов и в водных растворах. Гидриды поданы в печь через жиклер, а водные растворы введены с помощью микродозатора. Количественное определение токсичных элементов проведено калиброванным (градуированным) графическим методом. Оценена опасность наличия мышьяка и сурьмы в мясе выбранных для эксперимента рыб: маринки, карпа и толстолоба.

Ключевые слова: экологическая оценка, токсичные элементы, содержание сурьмы, мышьяк, органы, ткани рыб, предельно допустимая концентрация, здоровье человека.

Introduction. Fish and fish products are very useful for the human body. Fish meat has a high nutritional value, so fish dishes are widely used in the daily diet, in children's and diet food. The usefulness of fish is due, first of all, to the content of high-grade proteins easily digestible by the human body. The total amount of all protein substances in fish meat is, on average, about 16% and ranges from 12 to 22%. These include salt-soluble proteins such as globulins (myosin, actin, actomyosin, tropoliosin), water-soluble proteins such as albumins (myogen, myoalbumin, globulin, myoprotein). Myostromins, as well as nucleoproteins (histones, deoxyribose, purine and pyrimidine bases) have been identified. Fish meat proteins are complete, they contain all the essential amino acids in a well-balanced ratio for human consumption [1, 2].

In fish, especially in liver fat, caviar, internal fat, fat-soluble vitamins A, D and E are contained in a significant amount. Vitamins of group B (B1, B2, B3, B5, B6, B12) in fish meat are about the same as in meat warm-blooded animals. Any fish is a valuable and affordable source of phosphorus, fluorine and iodine. Particularly important is the content of the trace element iodine, which is very small in other foods. For example, cod meat contains 800-2440 times more iodine than beef. Of the minerals, fish meat contains: potassium, sodium, magnesium, chlorine, sulfur, phosphorus, iron and other elements (from 0.9 to 1.6% in total). Water in fish meat - 55-83%, the fatter the fish, the less water in its tissues. So, in the meat of eel it is about 55%, and in the meat of perch and cod - up to 80% [3; 4].

But at the same time, due to the presence of industrial and other hazardous waste, the fish absorbs all the toxic substances in the water, accumulates toxic elements in itself. The content of harmful elements such as antimony and arsenic is strictly regulated in the regulatory document "Sanitary rules, norms and hygienic standards of the Republic of Uzbekistan". Hygienic standards for food safety SanPin № 0366-19, which were reviewed and approved by the Committee for the Regulation of Potentially Unfavorable Factors of the Human Environment under the Ministry of Health of the Republic of Uzbekistan (Minutes No. 7 of December 27, 2018). In the environmental assessment of the environment, it is important to determine toxic elements, the content of which is very low and requires the use of highly sensitive physicochemical methods of determination [5, 6, 7, 8].

Methods and materials. Sampling of fish caught from the Zarafshan River and their preparation for analysis was carried out in accordance with GOST 26929 ``Raw materials and food products''. Basic preparations. Mineralization for detection of toxic elements''. This International Standard applies to food raw materials and specifies methods for dry digestion, wet digestion and acid separation for the determination of antimony and arsenic. The

method of dry mineralization achieved complete decomposition of organic substances by burning samples of raw materials in an electric furnace at a controlled temperature, then the sample was mineralized. Atomic absorption spectroscopy (AAS) is characterized by high sensitivity, reproducibility and selectivity. Determination of the content of antimony and arsenic in the organs and tissues of fish was carried out in accordance with GOST 30178 ``Raw materials and food products''. Method of atomic absorption detection of toxic elements'' on Spectr-1 and Saturn instruments equipped with electrothermal atomizers, with the help of which elements were determined in the form of hydrides and in aqueous solutions. Hydrides are fed into the furnace through a jet, and aqueous solutions are introduced using a microdoser. Quantitative determination of toxic elements was carried out by a calibrated (graded) graphical method [9, 10].

Results and its discussion. To study the content of antimony and arsenic, organs, tissues and whole carcasses (without entrails) of Marinka vulgaris, carp and common silver carp were taken. As a result of the analyzes, it was revealed that a little more arsenic is concentrated in the body of silver carp, while the level of antimony is higher in carp (table №1).

Table 1 - The amount of antimony and arsenic in the body of fish, mg/kg

№	Type of fish	Number of measurements	Arsenic $x \pm \Delta x$	Sr	Antimony $x \pm \Delta x$	Sr
1	Marinka ordinary	10	1,0±0,09	0,06	0,3±0,03	0,03
2	Carp	14	0,8±0,09	0,04	0,5±0,01	0,07
3	Silver carp ordinary	12	1,1±0,10	0,05	0,3±0,03	0,01

Table 2 - The results of the determination of toxic elements in the organs and tissues of fish in the Middle Zarafshan

№	Name of organs	Number of measurements	Arsenic $x \pm \Delta x$	Sr	Antimony $x \pm \Delta x$	Sr
1.	Marinka vulgaris	10				
	scales		-	-	0,75 ± 0,03	0,06
	leather		-	-	0,83 ± 0,02	0,03
	muscles		1,8 ± 0,07	-	0,21 ± 0,01	0,07
	skeleton		1,2 ± 0,05	0,05	-	-
	liver		-	0,06	0,3 ± 0,008	0,04
	swim bladder		-	-	0,2 ± 0,003	0,02
	black film		-	-	0,01±0,001	0,01
2.	Carp	14				
	scales		0,6±0,03	0,09	0,40 ±0,020	0,09
	leather		0,5±0,01	0,3	0,07±0,001	0,03
	skeleton		0,6±0,02	0,06	0,19±0,009	0,03
	gills		0,3±0,01	0,06	0,26±0,040	0,03
3.	The silver carp	12	-	-	-	-
	common		0,24±0,02	0,01	0,16±0,009	0,09
	scales		-	-	0,20±0,010	0,08
	leather		-	-	0,07±0,001	0,02
	muscles					

An analysis of the distribution of the studied elements in the organs and tissues of marinka, carp and silver carp specimens caught in the Middle Zarafshan showed that the concentration of arsenic and antimony in them is significantly higher than the background values. The organs and tissues of the common marinka are enriched with antimony and arsenic, while most of the antimony is concentrated in the scales and skin, and

its content is 3-4 times higher than in the muscles and liver. The average data of atomic absorption analysis of the distribution of antimony and arsenic in the tissues and organs of fish in the Middle Zarafshan shown in table № 2.

Table 2 shows that arsenic and antimony are the most dangerous when canning a number of fish. Most of these elements accumulate in the scales, skin, gills and skeleton of the fish. Recommendations for the processing of fish into canned food should include the removal of scales, skin, and heads of fish. The remains of these elements in the skeleton of fish for the entire mass of fish become much lower than the permissible value. When processing fish for fillets, the residual amount of arsenic and antimony does not pose a danger to human health [11, 12].

Conclusions. As can be seen from the tables, such a distribution of chemical elements is apparently associated with the lifestyle and species specificity of fish. The content of antimony found in the organs and tissues of fish is below the limit of permissible concentrations and therefore is not dangerous for humans and animals; As for the content of arsenic, its concentration in the muscles of the marinka is higher than the maximum permissible concentration (1 *mg/kg*), and eating this fish can pose a danger to human health.

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