внимания, хотя существует ряд исследований, где указывается существенное влияние заболевания на молочную продуктивность, влекущее большие экономические потери. В современной практики, для диагностики заболевания используют серологические и молекулярно-генетические методы исследования. По данным МЭБ РИД и ИФА являются рекомендуемыми тестами для серологической диагностики инфекции, вызванной вирусом лейкоза крупного рогатого скота [1]. Эти тесты были проверены с использованием международного эталонного стандарта сыворотки под названием Е05, который устанавливает минимальный уровень чувствительности, необходимый для рутинного тестирования образцов сыворотки и молока с использованием РИД или ИФА. Нами было исследовано 200 проб серологическими (РИД, ИФА) и гематологическим методами. Инфицированность в РИД составила 18,5%, в ИФА 21,5%. В результате гематологических исследований в 9 пробах абсолютное количество лимфоцитов (АКЛ) соответствовал показателям согласно лейкозному ключу больных животных. Стоит отметить, что в настоящее время наиболее эффективной стратегией борьбы с лейкозом предполагает выявление и уничтожение инфицированных животных, а также реализацию мер по недопущению ввоза инфицированных животных.

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MONITORING THE CONTENT OF HEAVY METAL SALTS IN FISH

Annotation

This article presents the results of a comprehensive assessment and analysis of the content of heavy metal salts in fish from water bodies of the West Kazakhstan region. The problem of purifying surface and waste water from heavy metals is quite acute and relevant for our country. Heavy metals, remaining toxic even in trace amounts, have a negative impact on water bodies and the human body. Untreated wastewater leads to a high degree of pollution of water bodies. Heavy metals cadmium and lead in muscle samples of fish living in the Bagyrlay rivers were contained in amounts of 0.018 mg/kg and 0.27 mg/kg; Berezovka river - 0.02 mg/kg and 0.33 mg/kg; Chagan river - 0.012 mg/kg and 0.21 mg/kg; Derkul river - 0.007 mg/kg and 0.21 mg/kg, Shyngyrlau river - 0.009 mg/kg and 1.15 mg/kg, Chizha 2 river - 0.001 mg/kg and 0.12 mg/kg, Chizha 1 river - 0.01 mg/kg and 0.24 mg/kg, respectively. According to the results of studies of 8 species of fish: pike, perch, rudd, roach, crucian carp, bream, tench, carp in the amount of 241 specimens from the reservoirs of the West Kazakhstan region the presence of a residual amount of lead compound on average 0.36 mg/kg and cadmium 0.0041 mg/kg was detected; toxic elements (arsenic and mercury) were not detected. Analysis of the content of heavy metals in fish does not exceed maximum permissible concentrations. These results indicate the relative safety of consuming fish from the studied water bodies.

Key words: heavy metals, lead, cadmium, reservoirs, maximum permissible concentrations, fish

Introduction. Aquatic ecosystems, including water bodies of the West Kazakhstan region, play a key role in maintaining biological diversity and ensuring food security. However, due to the intensive development of industry and an increase in anthropogenic activity, water basins are becoming susceptible to contamination with heavy metals. Fish, as important members of aquatic ecosystems, are a key subject of monitoring in the context of assessing the quality of water resources. At the same time, it is necessary to remember that chemical elements entering the human body accumulate in biological media and, influencing the chemical homeostasis of the body, can lead to the occurrence of various pathologies [1-4]. Pollution of most water bodies used by humans with heavy metals leads to a deterioration in the commercial quality of caught and farmed fish - this is one of the problems that has a number of theoretical and practical aspects that are important for modern fishing and fish farming. The amount of toxic substances entering water bodies with industrial, household and domestic wastewater amounts to tens of thousands, and every year this list is replenished with many new chemical compounds synthesized by humans that can pose a danger to animals, including aquatic organisms. Many of these substances exhibit mutagenic and carcinogenic properties, disrupt the structural and functional systems of the cell, affecting membrane formations, enzyme and genetic apparatus. Anthropogenic pollution of many heavy metals in water bodies to a decrease in the level of quality products characteristics of mined and bred fish. Every year the level of concentration of toxicants entering rivers, lakes, seas, oceans, with industrial wastewater, household and household waste is increasing due to the fact that the list of chemical compounds interacting with each other is supplemented by new, synthetic, posing a threat to humans, animals and aquatic organisms [5-9]. Majority chemical compounds have mutagenic and carcinogenic properties, they capable of causing structural and functional changes in cells, and also have a direct effect on membrane systems, genetic and enzyme apparatus [10-16].

A number of scientific studies have established that toxicants affect hydrobionts directly and indirectly, reducing fish stocks in water bodies, affecting every level of their life cycle, including spawning, food supply, area of distribution, as well as physicochemical and ichthyological systems reservoirs [17-19]. Heavy metals trapped into the water of the reservoir, are mainly deposited in bottom sediments, and the rest, under certain conditions, is introduced into food chains, and then into other components of the environment. At this time the process is influenced by the individual characteristics of aquatic organisms, in particular physiological and biochemical, since this transition is quite difficult process [20].

The purpose of this study is to conduct a comprehensive assessment of the content of heavy metal salts in fish from water bodies of the Western Kazakhstan region. Analysis of the content of heavy metals in fish tissues allows not only to assess the ecological state of aquatic systems, but also provides important data for understanding the possible risks to human health associated with the consumption of fish from these bodies of water.

Materials and methods of research. To determine residual amounts of heavy metal compounds in fish samples, the following methods were used: GOST 26932-86 Methods for determination of lead; GOST 26933-86 Raw materials and food products. Methods for determining cadmium; GOST 26927-86 Raw materials and food products. Methods for determining mercury; GOST 31628-2012 Food products and food raw materials. Stripping voltammetric method for determining the mass concentration of arsenic. The study was conducted on the basis of the NJSC WKATU named after Zhangir Khan, the laboratory of the West Kazakhstan branch of the RSE at the Republican Veterinary Laboratory of the KVKN of the Ministry of Agriculture of the Republic of Kazakhstan in 2022-2023. The objects of the study were fish from water bodies of the West Kazakhstan region.

Figure 1 - Fish sampling

Research results. The state of the fishing industry in the Republic of Kazakhstan is directly related to the ecological state of the country's water bodies, namely the anthropogenic impact on the hydrosphere. Pollution of water bodies with heavy metals leads to the accumulation of these toxicants both in the environment and in aquatic organisms themselves, which, in turn, leads to a decrease in the quality of fish products. Due to the fact that human health to a certain extent depends on environmental factors, with the intensification of technogenesis, the relevance of ecological and hygienic monitoring of the environment. Since water has high dynamism, significance and reliability of research results, limited only the indicators of pollutants in water are reduced.

Establishing the degree of contamination of fish with residual amounts of heavy metal compounds in water bodies of the West Kazakhstan region.

The results of a study of fish samples (2022) from 15 water bodies of the West Kazakhstan region for the content of residual amounts of heavy metal salts are shown in Figure 1.

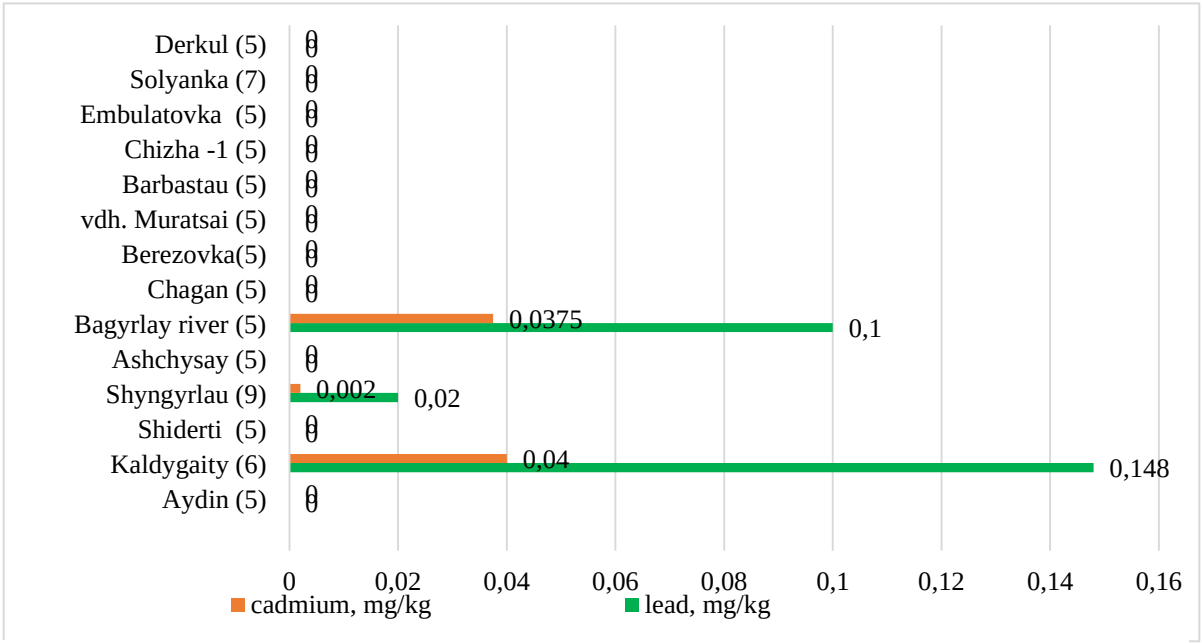

Figure 2 – Content of toxic elements in fish from water bodies of Western Kazakhstan in 2022

From Figure 2 it follows that of the four heavy metals, only cadmium and lead were found in muscle samples of fish living in Kaldygaity river - 0.04 mg/kg and 0.148 mg/kg; Shyngyrlau river - 0.002 mg/kg and 0.02 mg/kg; Bagyrlay river - 0.0375 mg/kg and 0.1 mg/kg, respectively; no toxic elements were found in the remaining eleven reservoirs.

Cadmium is one of the toxic and non-biogenic metals. Since cadmium is poorly excreted from the body, the degree of its accumulation in the organs and tissues of fish throughout the entire life period is high. In many cases, cadmium can replace zinc in zinc-containing enzymes, which can also lead to its accumulation.

Thus, in the organs and tissues of fish, an excess of the maximum permissible concentration for cadmium by 0.045 mg/kg was revealed. The patterns of accumulation of these metals in the tissues and organs of the studied fish are consistent with their biochemical role in the life of the organism.

Data from a study of fish samples (2023) from 7 reservoirs of the West Kazakhstan region for the content of residual amounts of heavy metal salts.

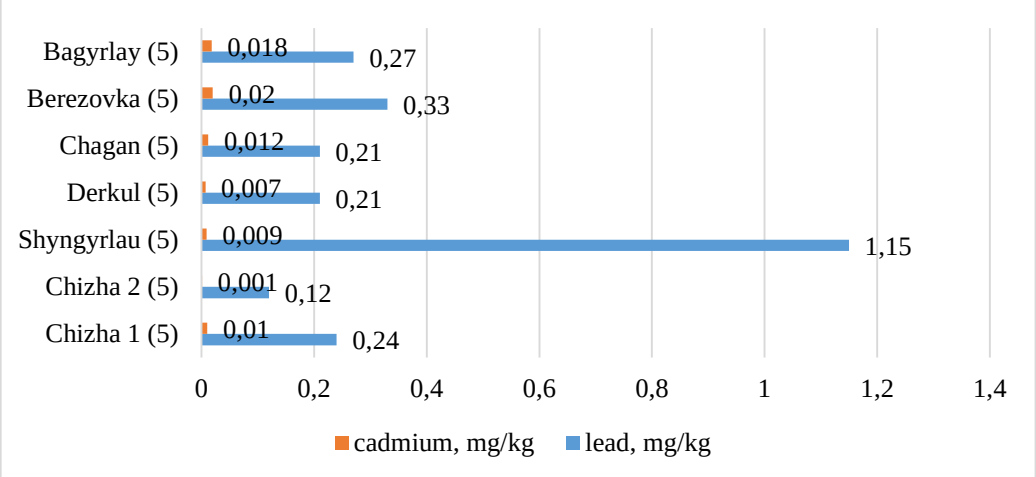

Figure 3 – Content of toxic elements in fish from water bodies of Western Kazakhstan (2023)

Thus, from Figure 3 it follows that the heavy metals cadmium and lead in muscle samples of fish living in the Bagyrlay rivers were contained in amounts of 0.018 mg/kg and 0.27 mg/kg; Berezovka river - 0.02 mg/kg and 0.33 mg/kg; Chagan river - 0.012 mg/kg and 0.21 mg/kg; Derkul river - 0.007 mg/kg and 0.21 mg/kg, Shyngyrlau river - 0.009 mg/kg and 1.15 mg/kg, Chizha 2 river - 0.001 mg/kg and 0.12 mg/kg, p Siskin 1 - 0.01 mg/kg and 0.24 mg/kg, respectively.

Thus, an excess of 0.15 mg/kg was observed for lead from fish from the Shyngyrlau River; lead is usually localized in the gills and fins, that is, in those structures that are in contact with water and through which the metabolic communication of organisms with the aquatic environment is carried out, which is associated with a significant technogenic load exerted on the state of the aquatic ecosystem by enterprises of the Burlinsky district of the West Kazakhstan region.

Figure 4 - Weighing fish

According to the results of studies of 8 species of fish: pike, perch, rudd, roach, crucian carp, bream, tench, carp in the amount of 241 specimens from the reservoirs of the West Kazakhstan region (rivers Chizha-2, Chizha-1, Derkul, Chagan, Berezovka, Utva, Bagyrlay) the presence of a residual amount of lead compound on average 0.36 mg/kg and cadmium 0.0041 mg/kg was detected; toxic elements (arsenic and mercury) were not detected.

In modern conditions of the continuing anthropogenic load of HMs on the water bodies of the studied territory, natural fish populations are subject to their toxic influence, which, against the backdrop of climate change processes, may increase the danger of a decrease in the biological diversity of ichthyofauna in general and a reduction in the number of valuable fish species. The observed effects must be taken into account when VSE of fish and assessing the condition of existing protected areas. Despite the results obtained, we consider it important to note that the problem of product contamination with HM salts is acute both in the Republic of Kazakhstan and in the world as a whole. In this regard, some scientists recommend extracting heavy metals from the muscle tissue of cut fish by two-stage exposure to a phosphate solution followed by exposure to an acid solution. The authors' research has shown that this raw material, which has undergone a detoxification procedure, can be used to prepare dried fish products. As a result of the analysis of the presented data, we can conclude that the main cause of pollution of aquatic ecosystems with heavy metals is anthropogenic impact caused by the flow of wastewater from industrial enterprises and municipal services. Based on the measures proposed and regulated at the legislative level, the most effective and efficient can be, on the one hand, the creation of closed production cycles using recycled water, the development and implementation of water-saving and low-waste technologies to reduce the anthropogenic load on surface and wastewater. On the other hand, it is necessary to create new and improve existing physical and chemical methods for purifying water from heavy metals, primarily the development of low-cost and more environmentally friendly organic sorbents and biological purification methods with increased efficiency. Small rivers flowing within cities with developed industry experience significant man-made load. The main cause of pollution of water bodies in urban areas is the discharge of untreated or insufficiently treated industrial wastewater. A pressing environmental problem is the

progressive pollution of water bodies with heavy metals. From water bodies, toxicants can enter the human body through food chains. Having cumulative characteristics, metals are capable of exhibiting carcinogenic, mutagenic and teratogenic properties. Due to the fact that human health to a certain extent depends on environmental factors, with the intensification of technogenesis, the relevance of conducting an environmental and hygienic assessment of the state of the environment increases.

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ТҮЙІН

Бұл мақалада Батыс Қазақстан облысының су айдындарының балықтарындағы ауыр металл тұздарының құрамын кешенді бағалау және талдау нәтижелері берілген. Біздің еліміз үшін жер үсті және ағынды суларды ауыр металдардан тазарту мәселесі өте өткір және өзекті болып табылады. Ауыр металдар аз мөлшерде болса да улы болып қала береді, су қоймалары мен адам ағзасына кері әсер етеді. Тазартылмаған ағынды сулар су объектілерінің жоғары ластануына әкеледі. Бағырлай өзенінде мекендейтін балықтардың бұлшық ет үлгілерінде ауыр металдар кадмий мен қорғасын 0,018 мг/кг және 0,27 мг/кг мөлшерінде; Березовка өзені – 0,02 мг/кг және 0,33 мг/кг; Шаған өзені – 0,012 мг/кг және 0,21 мг/кг; Деркүл өзені – 0,007 мг/кг және 0,21 мг/кг, Шыңғырлау өзені – 0,009 мг/кг және 1,15 мг/кг, Чижа 2 өзені – 0,001 мг/кг және 0,12 мг/кг, Чижа 1 өзені 1 – 0,01 мг/кг және 0,24. сәйкесінше мг/кг. Батыс Қазақстан облысының су қоймаларынан 241 дана көлемінде балықтардың 8 түрін: шортан, алабұға, қаңбақ, балық, мөңке, қарақұйрық, сазан, сазанды зерттеу нәтижелері бойынша орта есеппен 0,36 мг/кг және кадмий 0,0041 мг/кг қорғасын қосылысының қалдық мөлшерінің болуы анықталды; улы элементтер (мышьяк және сынап) анықталмады. Балықтағы ауыр металдардың құрамын талдау шекті рұқсат етілген концентрациядан аспайды. Бұл нәтижелер зерттелген су қоймаларынан балықты тұтынудың салыстырмалы қауіпсіздігін көрсетеді.

АННОТАЦИЯ

В данной статье представлены результаты комплексной оценки и анализа содержания солей тяжелых металлов в рыбе водоемов Западно-Казахстанской области. Проблема очистки поверхностных и сточных вод от тяжелых металлов стоит достаточно остро и актуальна для нашей страны. Тяжелые металлы, оставаясь токсичными даже в следовых количествах, оказывают негативное воздействие на водоемы и организм человека. Неочищенные сточные воды приводят к высокой степени загрязнения водных объектов. Тяжелые металлы кадмий и свинец в пробах мышц рыб, обитающих в реках Багырлай, содержались в количествах 0,018 мг/кг и 0,27 мг/кг; река Березовка - 0,02 мг/кг и 0,33 мг/кг; река Чаган - 0,012 мг/кг и 0,21 мг/кг; р. Деркуль - 0,007 мг/кг и 0,21 мг/кг, р. Шынгырлау - 0,009 мг/кг и 1,15 мг/кг, р. Чижа 2 - 0,001 мг/кг и 0,12 мг/кг, р Чижи 1 - 0,01 мг/кг и 0,24 мг/кг соответственно. По результатам исследований 8 видов рыб: щука, окунь, краснопёрка, плотва, карась, лещ, линь, карась в количестве 241 экз. из водоёмов Западно-Казахстанской области (реки Чижа-2, Чижа- 1, Деркул, Чаган, Березовка, Утва, Багырлай) выявлено наличие остаточного количества соединений свинца в среднем 0,36 мг/кг и кадмия 0,0041 мг/кг; токсичные элементы (мышьяк и ртуть) не обнаружены. Анализ содержания тяжелых металлов в рыбе не превышает предельно допустимых концентраций. Эти результаты свидетельствуют об относительной безопасности потребления рыбы из исследованных водоемов.

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