пайдаланылды. Сиырлардың күйлеуін ынталандыру үшін және олардың күйге келгенін анықтау үшін алжапқышы бар күйіттеуші-бұқалар қолданылды.

Алынған нәтижелер сиырлардың күйлеуін сәйкестендіруде жатырға массаж жасаудың тиімді екенін көрсетті. Авторлардың пікірінше, сиырдың жыныстық мүшелерін трансректальды ынталандыру, әсіресе шүртекей мен жатырды электрлік ынталандыру іс жүзінде оң әсер етеді. Сонымен қатар, жыныстық мүшелерді ынталандырудың едәуір тиімді әдісі жыныстық мүшелерді 48 сағаттық аралықпен электроэякулятор (тоқ күші 10V) құралымен 3 минуттан 4 рет ынталандыру болды. Оған қоса, биологиялық белсенді заттарды және жыныстық қызметті ынталандырудың табиғи әдістерін қолдану сәйкестендіру нобайларының тиімділігін 15-20% арттырды.

УДК 637.073.051 ***DOI 10.52578/2305-9397-2023-3-1-183-193***
МРНТИ 68.41.31

Жексенаева А.Б., PhD доктор, основной автор, https://orcid.org/0000-0002-5766-8007
НАО «Университет Шакарима» 071412, г.Семей, ул. Глинки, 20А, Казахстан, asel1980@inbox.ru
Усенова Л.М., кандидат ветеринарных наук, https://orcid.org/0000-0001-5105-1041
НАО «Торайгыров университет», г.Павлодар, ул.Ломова, 64, 140008, Казахстан, lm_usenova@mail.ru
Муратбаев Д.М., PhD доктор, https://orcid.org/0000-0003-4765-8099
НАО «Университет Шакарима», г.Семей, ул.Глинки, 20А, 071412, Казахстан, mdm_semey@mail.ru
Билялов Е.Е., кандидат ветеринарных наук, https://orcid.org/0000-0002-8778-5335
НАО «Университет Шакарима», г.Семей, ул.Глинки, 20А, 071412, Казахстан, er_men67@mail.ru
Зайковская О.Н., кандидат ветеринарных наук, https://orcid.org/0000-0001-8089-0952
НАО «Университет Шакарима», г.Семей, ул.Глинки, 20А, 071412, Казахстан, zaykovskaya.olga@mail.ru

Zhexenayeva A.B., Doctor PhD, the main author, https://orcid.org/0000-0002-5766-8007
Shakarim University, Semey, Glinka str., 20A, 071412, Kazakhstan, asel1980@inbox.ru
Ussenova L.M., Candidate of Veterinary Sciences, https://orcid.org/0000-0001-5105-1041
Toraighyrov university, Pavlodar, Lomov str. 64, 140008, Kazakhstan lm_usenova@mail.ru
Muratbayev D.M., Doctor PhD, https://orcid.org/0000-0003-4765-8099
Shakarim University, Semey, Glinka str., 20A, 071412, Kazakhstan, mdm_semey@mail.ru
Bilyalov Y.E., Candidate of Veterinary Sciences, https://orcid.org/0000-0002-8778-5335
Shakarim University, Semey, Glinka str., 20A, 071412, Kazakhstan, er_men67@mail.ru
Zaykovskaya O.N., Candidate of Veterinary Sciences, https://orcid.org/0000-0001-8089-0952
Shakarim University, Semey, Glinka str., 20A, 071412, Kazakhstan, zaykovskaya.olga@mail.ru

THE RELATIONSHIP BETWEEN RADIATION AND MEAT QUALITY: ANALYSIS OF THE EFFECT OF RADIONUCLIDES ON FOOD FROM AREAS WITH A HIGH RISK OF RADIATION CONTAMINATION

ANNOTATION

Since the middle of the twentieth century, nuclear technologies have been used in medicine, energy, and the scientific environment. Despite the huge potential for the use of radioactive isotopes of thorium, radium, uranium, cobalt, iodine in various fields, there is also a huge risk of unforeseen situations that can have harmful consequences for the environment, including agriculture. Therefore, it is very important to monitor the quality of food in places with a high risk of radiation contamination, which was the purpose of this study. The work assessed the impact of radiation pollution on the quality of livestock products in Semey, Abai region in eastern Kazakhstan, near which a nuclear testing site was located before the collapse of the USSR. In the experiment, an analysis of milk and beef was carried out, the results of which showed that the quality of the products studied did not exceed the permissible norms, but still showed slight deviations from the average values. The assessment was carried out by comparing organoleptic and radiochemical parameters with regulatory requirements. In the selected 75 samples of milk and 75 samples of meat, the concentration of radioactive isotopes was determined, in addition, the appearance, visual and taste components of beef were evaluated. Organoleptic analysis did not demonstrate significant deviations from the norm, while micro–quantities of ^{90}Sr and ^{137}Cs isotopes were found in the samples using a gamma spectrometer, the concentration of which did not exceed acceptable values. Monitoring of such characteristics is necessary not only to protect the health of the local population, it also allows us to form a complete picture of the dynamics of the spread and impact of radionuclides on the environment in the longer term. The ability to carry out comprehensive control of food products will help prevent a number of diseases that arise in the process of harmful radioactive exposure.

Key words: *radiochemical analysis, radiation safety, gamma spectrometer, radiochemical analysis of milk.*

Introduction. The active development of nuclear technologies has helped to significantly simplify and solve a number of problems related to the production of electrical and thermal energy. However, in the process of studying them, the risks of using radioactive compounds were not always taken into account. Along with their study, other technologies developed in parallel, which over time helped to predict the possible consequences and risks of working with radioactive isotopes.

Radiation pollution poses a threat to living beings, flora and agrocenosis. So in Japan, after the extraordinary events in 2011, a number of regulatory measures were taken to control the quality of food, in particular, as a result of an accident at a nuclear power plant, the level of radioactive caesium in food products in this area significantly exceeded the permissible values. So in water its concentration reached 200 Bq/kg, and in meat – 500 Bq/kg (Osanai, M., 2021) [1].

Global catastrophes can occur due to the breakdown of technical equipment, as a result of terrorist attacks or the irresponsible use of nuclear technology. On the other hand, each such situation contributes to the development and implementation of new rules for the control, use and work with radioactive substances. Therefore, it is very important to act ahead of the curve and form an algorithm of actions in case of emergencies even before they occur.

Jing Wang training Group from China conducted research on the awareness and level of informing the population about nuclear technologies. It turned out that the level of awareness of the population correlates in relation to the place of residence, so that the population of territories located closer to the zones of nuclear pollution had more information about the consequences and negative impact that may arise as a result of such pollution (Wang, J., 2019) [2]. On the other hand, during the social surveys of Tetsura Nakamura, which were conducted among the residents of Kazakhstan who lived near the nuclear test sites of Semey, it turned out that 60 % of them are concerned about possible harm to health resulting from exposure to radioactive elements and their ingress into food (T. Nakamura, 2020) [3].

Natural disasters, including earthquakes and tsunamis, are also a great threat, which contribute to the destruction of existing systems or increase the radius of radiation dust propagation. So in 2013, Typhoon Haiyan caused the destruction of the Philippine nuclear research laboratory. Another striking example is the growth of the radiation background in 2020 as a result of the fires in Chernobyl, the area of which was contaminated with radiation dust as a result of a man-made disaster in 1986. (Naletoski, I., 2021) [4].

It follows from this that even over time, radiation pollution zones demonstrate a high level of danger, and pets raised in such zones may be unsuitable for further consumption (Aleshina, N., 2020) [5].

On the other hand, as Andrew Russell notes in his scientific work, without having a solid understanding of the quality of agricultural products, the local population may be wary of purchasing them, thereby reducing the profitability of enterprises and worsening the economic situation of the region (Russell, A., 2018) [6]. A joint study by scientists from Kazakhstan and Kyrgyzstan also raises the question of the degree of contamination of reservoirs with radionuclides (Severinenko, M.A., 2023) [7], which may also subsequently affect the quality of meat in cattle inhabited by these regions.

On the territory of the former Semipalatinsk nuclear test site, a scientific group led by Andrey Panitsky measured concentrations of ^{137}Csi ^{90}SR in lizards of the *Lacertidae* family, where the indicators differed from those for lizards inhabiting other ecosystems that had not previously been affected by radiation (Panitsky A., 2016) [8]. A similar analysis of the state of soil and plants for this region was carried out by Natalia Larionova (Larionova N., 2022) [9]. The results of these studies recorded an abnormally high level of ^{90}SR, which indicates the possible risks of radiation pollution and agricultural products of this region.

People's ignorance about the advantages of nuclear technologies and the availability of tools that are able to predict and eliminate possible risks associated with them can also form an erroneous opinion among the population about the safety of such technologies, which can significantly slow down the development of medicine, energy, as well as scientific progress in these regions.

That is why the purpose of our work was to develop methods of quality control of animal products intended directly for monitoring food safety in areas with a high risk of radioactive contamination. Such studies will not only shed light on the level of toxicity of food products in a particular region, but also help to form general rules that should be relied upon when studying the long-term effects of radiation on living beings and human health.

Materials and methods. The work investigated samples of meat and milk of cows raised in the Abai region in the east of Kazakhstan, namely in the city of Semey.

This area has experienced radiation effects from a nuclear test site, which was decommissioned after the collapse of the USSR, but the consequences of its activities have become a hotbed of radiation pollution.

As part of the study, meat samples of 75 cows raised by local residents, in particular farmers, namely fillet, were selected weighing 1 kg each. Analyses were carried out no more than 72 hours after slaughter, all samples were stored at a temperature of +4 ℃. Milk samples with a total volume of 37.5 liters were also taken for analysis.

Sampling was carried out from early spring to mid-December 2022.

Radiochemical analyses of meat and milk were carried out in order to determine the presence of a number of radioactive isotopes of heavy elements.

Radiochemical analysis. The radiochemical analysis of milk took place in several stages. First, the processing of raw materials took place. The milk was cooled to a temperature of +4 ℃, with preliminary sterilization of the vessel. Then, in order to concentrate radionuclides from milk, extraction was carried out using a 0.5 M solution of sulphate acid, followed by transfer of the resulting mixture to the filter. After removing excess water from the sample, the components were separated using Dowex 1×4 anion exchange resin using radioactive indicators. To extract the cesium isotope from a milk sample, a chelate extraction method was used. To do this, a sample of milk was taken and a solution of a chelating agent in the form of nitrilotriacetic acid (NTA) was added to it. To reduce the effect of other ions on the extraction process, a buffer solution mixture – tris (hydroxymethyl) was added to the milk solution aminomethanesulfonic acid.

Radioactivity was measured using gamma spectrometry (Md Moudud Hasan, 2023) [10], namely the Canberra SmartProbe system, which consists of a HPGe gamma spectrometer (a highly sensitive germanium detector system) and devices for preparing and moving samples.

For Kazakhstan, the standards for the content of radionuclides in food are established by the Committee for Nuclear Regulation and Control of Nuclear Materials on the basis of international recommendations and the results of monitoring the radiation situation in Kazakhstan.

The norms for the content of radionuclides in milk in Kazakhstan are set at the level of 5 becquerels per liter for Caesium–137 and 7 becquerels per liter for Strontium–90.

The norms of radionuclide content in beef tenderloin in Kazakhstan are set at the level of 200 becquerels per kilogram for Caesium–137 and 300 becquerels per kilogram for Strontium–90.

For the radiochemical analysis of meat samples, the raw tenderloin was cut into pieces in the form of cubes of 1 cm^3, followed by heat treatment at 110 ° C. After the mass of the sample was stabilized, it was crushed and submitted to homogenization (Duyssembaev, Sergazy, 2015) [11]. The ash was placed in glasses (0.1 l per 3 g of ash) by adding 0.1 M of phosphoric acid to increase the acidity of the solution and the solubility of strontium. Then a solution of barium chloride was added to the solution, which formed a precipitate of strontium barium apatite ($Ba\ Sr_{10}(PO_4)_6(OH)_2$), which contained all the strontium from the solution.

The resulting precipitate was thoroughly washed with distilled water to remove the remaining impurities and barium and transferred to a glass ampoule. Next, the sample was analyzed for the amount of strontium by gamma spectrometry, the concentration of activity measured in ash weight was converted back to wet weight.

Calculations of the concentration of radionuclides in samples from the measured values of gamma radiation, as well as the identification of radionuclides from the measured energies of gamma radiation were carried out on the basis of Peak Easy software, which is based on mathematical models of Beryl-Seiberg and Morell-Kristoff.

Based on the results of the gamma–spectrometry analysis, a number of conclusions were made about the degree of radiation load on the environment and human health.

Organoleptic analysis. The standards of organoleptic analysis of milk in Kazakhstan are established by the normative document «SAUS 31452-2012» Milk and dairy products. methods of organoleptic control». Compliance with the requirements of appearance, smell, taste, consistency, fat content, protein and lactose was checked.

The standards of organoleptic analysis of beef tenderloin in Kazakhstan are established by the State Committee on Public Health of the Ministry of Health of the Republic of Kazakhstan.

Results. The dynamics of the study and application of nuclear technologies in science and energy has increased rapidly over the past century. However, the properties of radionuclides and their effect on biological systems have not yet been studied to perfection. This is caused by a number of factors, in particular, the danger to the health of the researchers themselves who are in direct contact with radioactive radiation. The expansion of the scope of application of radiation extends not only to nuclear power. it concerns even such seemingly very distant industries as agriculture and medicine.

There are several world organizations involved in establishing rules and regulations that must be observed when using nuclear technologies. The International Atomic Energy Agency (IAEA) plays a key role in the development and improvement of international standards and regulations for the safety of nuclear energy. It is also engaged in the control and supervision of the peaceful use of nuclear energy and the prevention of the proliferation of nuclear weapons. Another organization of a similar profile – NSG (National Security Group) develops and applies guidelines and rules for the control of nuclear exports, establishes restrictions and requirements to prevent the illegal proliferation of nuclear materials and technologies. The WNA (World Nuclear Association) represents the interests of the international nuclear industry and works to establish standards for the safety, economic development and sustainability of nuclear energy. It promotes the exchange of information and experience, as well as ensures cooperation between countries in the field of nuclear technologies. And although there are world organizations involved in creating rules that must be observed when using nuclear technologies, in real life it is not always possible to monitor compliance with these rules. Also, due to the destructive power of these technologies, tools for terrorist acts can be created on their basis. Therefore, it is necessary not only to create rules for working with radioactive compounds, but also to be prepared for possible threats in the long term [12].

In this work, a combined monitoring of the quality of several food products from an area with a high risk of radioactive contamination was carried out. The most common agricultural products were selected.

The city of Semey was not chosen by chance. After all, conducting nuclear tests near this city during the Soviet era created, on the one hand, a number of stereotypes that reduced the demand for agricultural goods in this region, which affected its economic situation, on the other hand, the study of the effect of radiation on the biosphere can help form a general idea of the long-term impact of radiation on living organisms.

During the experiment, the local population demonstrated loyalty and was also interested in participating in the process. However, there were problems in communication with local authorities, which significantly slowed down the processes of scientific research.

The task was to create a comprehensive analysis method that would allow us to understand how safe food products, namely are milk and meat. On the other hand, further research should pay attention to other food products, as well as monitor the quality of groundwater, which directly affects the quality of agricultural products.

The samples were divided into five blocks, in each of which, when analyzing the results obtained, they relied on the average value of indicators to output general statistics.

As part of the organoleptic method of milk analysis, attention was primarily paid to its appearance. Milk samples in 4 out of 5 blocks met the standards and had no impurities, deposits, and also had a white color. The samples from the last block, taken at the end of autumn, had a slightly darker color, but this may be due to seasonality, a decrease in air temperature and a change in the diet of cows whose milk was analyzed.

The smell of milk in most samples was pleasant, without notes of mustiness. There was no acid or bitterness in the taste of the milk. For the objectivity of the evaluation of the characteristics, independent experts were also involved, who, in case of inaccuracies, could give their comments on the taste qualities of milk in each of the blocks.

The consistency of the samples that were selected in the colder season was a little thicker, but not so thick as to indicate poor quality of these products. The chemical composition of the samples was also analyzed, the data of which are listed in Table 1.

Table 1 – Chemical composition of milk samples

Sample	Protein content, %	Fat content, %	Lactose content, %	Ash content, %	Water content, %
1	3.2	2.9	4.8	0.4	82.4
2	3.1	3.0	4.7	0.5	85.5
3	3.3	2.8	4.9	0.8	86.2
4	3.2	2.9	4.8	0.7	87.4
5	3.0	3.1	4.6	0.4	81.9

Source: Compiled by the authors

According to the norms of Kazakhstan (SAUS 31451-2013 «Milk and dairy products. Methods for determining the mass fraction of fat») for milk, the protein content should be at least 2.8%, the fat content should be at least 2.5%, the lactose content should be at least 4.5%, the ash content should not exceed 0.8%, and the water content should not exceed 88.3%. According to the table, all milk samples comply with the norms, since their indicators do not exceed the established values.

The overall organoleptic score was 4.2 points out of 5, which fully meets the standards according to SAUS 31450-2013.

During the organoleptic analysis of beef, the samples were also divided into 5 blocks. The color of the meat, according to observations, was uniform, red–brown in most samples. There were no foreign odors. The meat was soft, elastic and homogeneous in consistency. The humidity level was also checked, which did not exceed 72%, which indicates that the meat complies with the standards adopted for Kazakhstan.

There were no helminths in the samples. Also, chemical indicators and microbiological analysis were analyzed, the results of which the meat is completely suitable for human consumption, which is shown in Table 2.

Table 2 – Chemical composition of milk samples

Sample	Ash content, %	Fat content, %	Acidity, °T
1	0.5	5.0	7
2	0.6	7.5	7.8
3	0.4	6.8	6
4	0.7	9.0	7.9
5	0.3	6.5	5

Source: Compiled by the authors

The beef tenderloin had to be fresh, and was stored at a temperature no higher than +4 degrees Celsius. The protein content in the samples ranged from 24% to 35%.

To exclude the presence of radioactive contamination, an analysis was carried out for the content of radioactive isotopes of caesium and strontium. The measurements were carried out using a gamma spectrometer, the results of which were processed and analyzed. The results were entered in table 3.

Table 3 – Results of radioactive analysis of beef tenderloin for the content of isotopes caesium–137 and strontium–90

Sample	Cesium–137, Bk/kg	Strontium–90, Bq/kg
1	56	14
2	81	12
3	71	10
4	45	8
5	62	11
LPP	600	200

Source: Compiled by the authors

The corresponding analysis of milk samples was also carried out, the results of which were also recorded in Table 4.

Table 4 – Results of radioactive analysis of milk for the content of isotopes of caesium–137 and strontium–90

Sample	Cesium–137, Bk/kg	Strontium–90, Bq/kg
1	9.2	2.1
2	14.7	1.8
3	11.5	2.5
4	7.8	1.3
5	10.1	1.7
LPP	37	3

Source: Compiled by the authors

In our studies, the radionuclides found in samples of animal products did not exceed acceptable levels. Nevertheless, their presence in food makes us think about further monitoring of such indicators. The presence of isotopes of other radioactive elements in the composition of the studied foods were not observed in this experiment. On the other hand, it is worth noting that when changing research methods, such observations can be strikingly different. And although the indicators of organoleptic analysis corresponded to the established standards, the very fact of the presence of radioactive elements in the samples should indicate the need for further research with the involvement of scientists who will be able to analyze the measure of the impact of radiation on the environment from the point of view of radiochemistry, biology, geology and other related sciences.

Discussion. Studying the problem of the influence of radionuclides on biological systems, one may encounter a shortage of scientific papers in this field. This may be due to problems of communication between the state apparatus and scientists, as well as poor coordination of scientific groups among themselves. The problem of the influence of radioactive radiation on biomes and human health belongs to the category of interdisciplinary research and requires specialists in various fields in its arsenal. Also, for objects that are protected by the state, for example nuclear power plants, there are difficulties in obtaining appropriate permits, both for citizens of the countries in which these objects are located, and for foreign specialists. All this leads to a number of difficulties on the way to the study of places with a high risk of radiation pollution and especially the zones of recent nuclear disasters.

From year to year, scientists systematically strive to contribute to improving the state of the world by exploring new approaches to improving the quality of life of the population.

In his work, Tetsuya Nakamura notes that the measures applied by the population from places of radiation pollution are insufficient, and people are practically unaware of the level of safety of the area, as well as possible dangers that may occur due to changes in the radiation background (Nakamura T., 2021) [13].

To understand how radionuclides affect living organisms, it is first of all worth reading the book by Ivancho Naletoski, who closely cooperates on nuclear technologies with the FAO/IAEA, and also studies their impact on the food industry and agriculture. In his work, he suggests data that demonstrate that the loss of radionuclides from soft tissues occurs more likely than from bones. There is also a selective accumulation of certain isotopes in tissues, such as ^{90}Sr, ^{131}I and ^{137}Cs (Naletoski, I., 2021) [4, 14]. At the same time, studying the influence of isotopes ^{90}Sr and ^{137}Cs and other heavy radioactive metals on the health of fish living in Chernobyl, the scientific group of Adelaide Lerebour noted in their works that the reproductive functions of most fish and their general physiological state are quite satisfactory, deviations and sensitivity to radiation were observed only in perch (Lerebours, A., 2018) [15]. This indicates that not only do different types of animals react differently to radioactive radiation, the measure of susceptibility to radiation can be variable even from species to species.

Isotopes of ^{131}I can accumulate in the thyroid gland of animals and humans, but it is easier to eliminate it by biochemical means than other isotopes (Howard B., 2021) [16]. It has also been noted in modern works that brown algae can bind ^{129}I when it enters open reservoirs (Fievet B., 2023) [17]. A more serious threat is the isotopes ^{90}Sr and ^{137}Cs, which penetrate through dairy products into baby food, which can cause the development of cancers, depending on the concentration. Such impurities in the products will be extremely toxic and can lead to death. In order to prevent such situations, it is worth carefully monitoring the content of these radioactive elements based on already known radiobiological indicators, which are shown in Table 5.

The accumulation of radionuclides also occurs in the muscles of animals. Animals and animal products often have fast and slow components of their retention in the body. The range of values of biological half-lives of radionuclide activity concentrations and the proportion of radionuclide loss in the first component are presented in Table 6. When breeding animals in areas with a high risk of radiation pollution, these factors must also be taken into account, and a number of regulatory laws must be adopted at the legislative level that will prohibit the sale of products whose indicators go beyond the limits of the limit permissible ranges.

Table 5 – Transfer coefficients (Fm, d/kg) of radionuclides, for cow's milk

Element	N Sample Size	geometric mean	Minimum	Maximum
^{90}Sr	289	4.9×10^{-3}	6.0×10^{-4}	5.7×10^{-2}
^{131}I	105	6.0×10^{-3}	4.0×10^{-4}	4.4×10^{-2}
^{137}Cs	118	1.3×10^{-3}	1.5×10^{-5}	4.3×10^{-3}

Compiled on the basis of Naletoski, I., 2021

Table 6 – The range of values of biological half-lives of radionuclide activity concentrations and the proportion of radionuclide loss in the first component in cattle muscles

Radioactive element	The share of radionuclide losses in the first component	Biological half-life	
		Fast loss	Slow loss
^{90}Sr	0.42–0.9	3.0–4.0	180–700
^{131}I	1.0	7.0	
^{137}Cs	0.37–0.93	3.0–22.3	36.3–81

Compiled on the basis of Naletoski, I., 2021

In the literature, studies are given for samples of cow meat in significant quantities, therefore, using its example, it is best to observe the dynamics of the accumulation and influence of radioactive elements on the animal body with a projection on the time elapsed since the greatest concentration of radioactive dust in soil, reservoirs and air.

A more global study of the effects of radiation on a number of foods was conducted by the Minoru Osanai research group. Their work talks about reducing radiation contamination of food 4 years after the Fukushima accident (Osanai, M., 2021) [1]. This gives positive forecasts for the possibility of partial exploitation of territories that were in areas of high radiation background.

Another group of scientists (Zlobina, A., 2022) came to similar conclusions regarding the reduction of the level of radiation influence on the health of people living in areas with high levels of radiation pollution [18].

On the other hand, as part of the work of Iranian scientists, it was indicated that the concentration of radioactive ^{226}Ra in the food of the local population exceeded the established norms (Fathabadi, N., 2017) [19]. The high level of radiation in Ramsar is associated with natural water sources containing a large amount of radioactive elements. Similar phenomena indicate the possibility that natural disasters may affect changes in the radioactive background. And although this experiment did not include an analysis of the effect of other radionuclides on the quality of products, it is worth noting that local scientists and authorities have developed a number of projects to stabilize the situation with radiation safety.

The meat safety control system has a number of shortcomings that are fraught with serious consequences for the health of consumers, scientists from the Norwegian University of Natural Sciences (Blagojevic B., 2021) also note this in their work [20]. Thus, modification of existing control methods, their combination, as well as the use of innovative alternative research methods contribute to overcoming existing shortcomings.

A similar alternative may be the method of accurate assessment of beef quality using hyperspectral imaging (HSI), developed by a group of scientists from Spain led by Sara Leon–Ecay (León–Ecay S., 2022) [21]. Their approach reduces the impact of human bias on the results of food quality analysis. That is, the use of technical means becomes an advantage and significantly reduces the time spent on the study of one sample. However, in this work, technical means were not used to irradiate meat, but on the contrary to measure the level of radioactive radiation. This allows you to automate the process and get specific values, the error of which is minimized.

It is also worth noting that the use of radiation radiation can have a positive effect on the same foods. A number of scientific papers have noted that by irradiating products with X-ray waves, it was possible to safely and effectively destroy parasites and small insects in food, thereby prolonging their shelf life (Ahari, H., 2012; O'bryan, C. A., 2008; Singh, R., 2020) [22, 23, 24].

In summary, it is worth noting the ambiguity in the approach to the use of nuclear technologies and the limited means of monitoring their functioning. The development of modern high-tech methods of food monitoring can significantly contribute to the settlement of many issues related to the safety of such technologies. It will also help to increase the tolerance of society to new developments in this area.

Conclusion. In the course of the study, methods of analyzing dairy and meat products were proposed on the example of cow's milk and cow meat grown in an area with an increased risk of radiation contamination. Comparing the results of the work done with the preliminary results of other scientists who studied this problem, you can notice a positive trend. However, it should be noted that in order to get a general picture of the impact of radiation pollution on the terrain and the quality of food, it is necessary to involve expert groups, regularly measure a number of biochemical and radiochemical indicators of soil, water resources, as well as analyze the level of morbidity and the frequency of visits to medical institutions by representatives of the local population.

Given the tendency of the world to rapid changes, it is important to form algorithms for responding to emergency events, as well as comprehensive tools aimed at preventing and preventing man-made disasters. Regular monitoring of food quality will contribute to the prevention of damage to the population, as well as forecasting and modeling the degree of exposure to radioactive dust in the long term.

Summing up, it is advisable to note that the impact of radiation pollution on animal husbandry is weakened every year in the absence of new sources of such pollution. However, this may be caused by the deposition of radioactive isotopes in the middle layers of the soil, where they are almost isolated from entering groundwater, or pet food. Therefore, we should not exclude the possibility of regression of indicators, as well as the influence of additional factors on them. That is why it is worth conducting further research in the direction of studying these territories, but additionally taking into account their vulnerability to pathogens. Earthquakes can become a big problem, which can radically and unpredictably change the level of radioactive contamination of the area. In the event of such situations, rapid response and the availability of formed approaches to product quality control will help to preserve the health and life of many people.

Thus, such research can be characterized as useful and essential, given that nuclear technologies still pose a significant threat to society. This threat should be minimized in a timely manner to prevent its spread.

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ТҮЙІН

XX ғасырдың ортасынан бастап ядролық технологиялар медицинада, энергетикада, сондай-ақ ғылыми ортада қолданыла бастады. Торий, радий, уран, кобальт, йодтың радиоактивті изотоптарын әртүрлі салаларда қолданудың үлкен әлеуетіне қарамастан, қоршаған ортаға, соның ішінде ауыл шаруашылығына зиянды әсер етуі мүмкін күтпеген жағдайлардың үлкен қаупі бар. Сондықтан радиациялық ластану қаупі жоғары жерлерде азық-түлік сапасын бақылауды жүзеге асыру өте маңызды, бұл зерттеудің мақсаты болды. Жұмыста Қазақстанның шығысындағы Абай облысы, Семей қаласының мал шаруашылығы өнімдерінің сапасына радиациялық ластанудың әсерін бағалау жүргізілді, оның жанында КСРО ыдырағанға дейін ядролық сынақтар жүргізуге арналған полигон орналастырылған болатын. Экспериментте сүт пен сиыр етіне талдау жүргізілді, оның нәтижелері зерттелетін өнімдердің сапасы рұқсат етілген нормалардан аспайтынын, бірақ әлі де орташа мәндерден шамалы ауытқуларды көрсететіні анықталды. Бағалау органолептикалық және радиохимиялық көрсеткіштерді нормативтік талаптармен салыстыру арқылы жүргізілді. Таңдалған 75 сүт сынамасы мен 75 ет сынамасында радиоактивті изотоптардың концентрациясы анықталды, сонымен қатар сиыр етінің сыртқы түрі, визуалды және дәмдік компоненттері бағаланды.

Органолептикалық талдау нормадан айтарлықтай ауытқуларды көрсетпеді, ал гамма-спектрометр көмегімен үлгілерде концентрациясы рұқсат етілген мәндерден аспайтын ^{90}Sr және ^{137}Cs изотоптарының микромөлшерлері табылды. Мұндай сипаттамаларды бақылау тек жергілікті халықтың денсаулығын сақтау үшін ғана қажет емес, сонымен қатар радионуклидтердің таралу динамикасы мен қоршаған ортаға әсерінің ұзақ мерзімді перспективада біртұтас көрінісін қалыптастыруға мүмкіндік береді. Азық-түлікті кешенді бақылауды жүзеге асыру мүмкіндігі зиянды радиоактивті әсер ету процесінде пайда болатын бірқатар аурулардың алдын алуға көмектеседі.

РЕЗЮМЕ

Со середины XX века ядерные технологии находят своё применение в медицине, энергетике, а также научной среде. Не смотря на огромный потенциал использования радиоактивных изотопов тория, радия, урана, кобальта, йода в различных сферах, существует также огромный риск возникновения непредвиденных ситуаций, которые могут иметь пагубные последствия для окружающей среды, в том числе сельского хозяйства. Поэтому очень важно осуществлять контроль качества продуктов питания в местах с высоким риском радиационного загрязнения, что и стало целью данного исследования. В работе была проведена оценка влияния радиационного загрязнения на качество продуктов животноводства города Семей, Абайской области на востоке Казахстана, вблизи которого до распада СССР размещался полигон для проведения ядерных испытаний. В эксперименте проводился анализ молока и говядины, результаты которого показали, что качество исследуемых продуктов не выходят за рамки допустимых норм, но всё же демонстрируют незначительные отклонения от среднестатистических значений. Оценка проводилась путём сравнения органолептических и радиохимических показателей с нормативными требованиями. В отобранных 75 пробах молока и 75 пробах мяса определяли концентрацию радиоактивных изотопов, кроме того, была проведена оценка внешнего вида, визуальных и вкусовых составляющих говядины. Органолептический анализ не продемонстрировал значительных отклонений от нормы, при этом в образцах с помощью гамма-спектрометра были найдены микроколичества изотопов ^{90}Sr и ^{137}Cs, концентрация которых не превышала допустимых значений. Мониторинг таких характеристик необходим не только для охраны здоровья местного населения, он также позволяет сформировать цельную картину динамики распространения и влияния радионуклидов на окружающую среду в более длительной перспективе. Возможность осуществлять комплексный контроль продуктов питания помогут предотвратить ряд заболеваний, возникающих в процессе пагубного радиоактивного воздействия.

УДК 619:616.995.122 (574.1) ***DOI 10.52578/2305-9397-2023-3-1-193-199***
МРНТИ 68.41.55

Жумабаев А.К., магистр ветеринарных наук, **основной автор,** https://orcid.org/0000-0002-1504-2831
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Казахстан, as9982998@mail.ru
Кушмуханов Ж.С., магистр ветеринарных наук, https://orcid.org/0000-0002-5132-7359
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Казахстан, jenis.90@mail.ru
Нургалиев Б.Е., кандидат ветеринарных наук https://orcid.org/0000-0001-5998-8250
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Казахстан, nurgaliev.79@mail.ru
Кадралиева Б.Т., магистр ветеринарных наук, https://orcid.org/0000-0002-5161-5561
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Казахстан, bkadralieva@mail.ru
Усенов Ж.Т. магистр ветеринарных наук, https://orcid.org/0000-0002-2100-1948
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Казахстан, usenov79@mail.ru