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Features of Veterinary and Sanitary Examination of Carcasses and Organs of Animals Exposed to Radiation

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Abstract:
The article examines the features of veterinary and sanitary examination of carcasses and organs of animals exposed to radiation, shock waves and light radiation. Data on pathological changes depending on the degree of irradiation, time of slaughter and doses of radioactive substances are provided. The results of dosimetric and radiometric control, the effect of radiation on the metabolism of animals and the processes of meat maturation are described. Particular attention is paid to the assessment of radioactive contamination of livestock products, the conditions of their use or disposal depending on the level of radionuclides, as well as recommendations for veterinary and sanitary examination. Data on the accumulation of cesium-137 and strontium-90 in the organs and tissues of animals, as well as practical measures to reduce radioactive contamination and ensure the radiation and hygienic safety of products are provided.
Keywords: poisoning of animals with radioactive substances, results of dosimetry and radiometry, veterinary and sanitary examination, toxic doses, bacteriological research.

Introduction

Veterinary and sanitary examination of carcasses and organs of animals exposed to shock waves, light radiation and radiation is carried out in accordance with generally accepted methods [1]. Carcasses and organs of animals with mechanical damage (fractures, bruises, etc.) are removed in accordance with the rules for veterinary examination of these animals and veterinary and sanitary examination of meat and meat products. In case of poisoning of animals with radioactive substances, the results of dosimetry and radiometry are taken into account [2-7]. Many scientists have considered issues on this problem and made the following conclusions.

Scientists in [8] analyzed the data of veterinary and sanitary examination of carcasses and internal organs of game animals in the Krasnodar Territory. Based on data on the epizootological and parasitic situation in the territory of the Krasnodar Territory for the period from 2011 to 2017, the number of unfavorable points of wild fauna was about 22 (6.1%). In the article [9], the scientists monitored liver lesions in cattle (cows, heifers, fattening bulls and culled calves), pigs (sows, fattening pigs and culled piglets), sheep (ewes and lambs), goats (females and kids), rabbits and poultry (layers, broilers, turkeys, domestic ducks and domestic geese) from 2010 to 2021. The analysis included all animals (n = 1,425,710,143) raised on Czech farms and slaughtered in slaughterhouses in the Czech Republic, where they determined the total number of liver lesions for individual animal categories, and separately analyzed the frequency of lesions of acute, chronic, parasitic and other origin.

The article [10] is devoted to the study of the effectiveness of a radioprotector based on substances of microbial origin (VMP) and the veterinary and sanitary examination of slaughter products in case of radiation injuries of animals against the background of the use of VMP. The effect of the radioprotective drug VMP on the sanitary and hygienic indicators and the completeness of meat obtained from animals treated with VMP, non-irradiated and irradiated at a dose of 6.0 Gy 15 days after treatment was studied. At the same time, 30 carcasses of control, irradiated and treated sheep were subjected to veterinary and sanitary examination.

The purpose of this article is to consider the features of veterinary and sanitary examination of carcasses and organs of animals exposed to radiation, shock waves and light radiation.

2. Materials and Methods

During the veterinary and sanitary examination of carcasses and organs of animals damaged by light radiation from a nuclear explosion or heat exposure from a fire, attention is paid to pathological changes, the nature of which depends on the area of the burn and the time of slaughter of the animals after the injury. If the burn area does not exceed 5% of the body surface, local changes are observed only in the skin and subcutaneous tissue [11]. If up to 10% of the body surface is damaged and the animals are slaughtered in the first 2-3 days after the injury, necrosis of the skin at the site of the lesion, edema of the subcutaneous tissue of the affected area, an increase and slight swelling of the regional lymph nodes on the burned side of the carcass, slight weakness of the heart muscle are noted. Fluid accumulation in the pericardium, congestive hyperemia in the lungs, liver, kidneys, sometimes hemorrhages under the renal capsule, edema of the mucous membrane of the gastrointestinal tract with severe hemorrhage. These changes become more pronounced in animals with extensive burns (more than 10% of the body surface) after six or more days. When slaughtering animals with extensive burns 10-15 days after thermal injury, pleurisy, peritonitis, pneumonia and other complications are noted.

Carcasses and organs of animals exposed to radiation, killed during the first 4 days at normal temperature, are removed without restrictions. When slaughtering animals with fever, samples should be taken after 3 days and bacteriological and physicochemical analyses should be carried out. Animals exposed to external gamma irradiation are sent for slaughter; if slaughter was carried out during the latent period of radiation sickness and no pathological changes were detected during the examination, the meat is used without restrictions. If deviations from the norm are detected, the carcass is assessed in accordance with the rules for veterinary inspection of slaughter animals and veterinary and sanitary examination of meat and meat products. In the carcasses and internal organs of animals that have been severely affected by radiation, characteristic changes in the latent period are small hemorrhages along the coronary vessels in the epicardium, in the mucous membrane of the gastrointestinal tract,

in the kidneys, lymph nodes, and pulmonary edema. Destructive changes are observed in the bone marrow, which in severe cases can be destroyed within the next 2-3 days. It contains a very small number of hematopoietic cells and is represented mainly by fat, reticular, and plasma cells (spongy bones at the site of the cut are yellow). During the period of exacerbation of radiation sickness, destructive changes develop in the subcutaneous tissue and skin, internal organs, serous and mucous membranes of parenchymatous organs, necrobiotic areas and tissues (necrosis of the mucous membrane of the oral cavity, pharynx, laryngitis), profuse hemorrhages (petechiae and ecchymoses). Bleeding of organs and tissues, aplasia of the bone marrow, a change in its characteristic color (darkening) and density are observed. In the lungs - foci of congestion, edema, hemorrhages and destructive-sclerotic changes. Inflammatory phenomena are observed in the large and small intestines, accompanied by the appearance of necrotic and fibrinous deposits. Significant destructive changes with foci of necrosis are observed in the liver; in the kidneys, especially in the mucous membrane of the small pelvis - dystrophic changes and hemorrhages. In the heart, under the epicardium and inside the muscles there are profuse hemorrhages, dystrophic changes in muscle fibers. In animals that died during the elimination of radiation sickness, traces of hemorrhages are found in the form of hemosiderin accumulation in the intestinal mucosa, as well as hemosiderosis of the lymph nodes, giving them a rusty color [12].

Destructive changes with necrotic foci are visible in the liver, degenerative changes and hemorrhages are observed in the kidneys, especially in the mucous membrane of the pelvic cavity. In the heart, under the epicardium and inside the muscles - profuse hemorrhages, dystrophic changes in muscle fibers. In animals that died during the elimination of radiation sickness, traces of hemorrhages are found in the form of accumulation of hemosiderin in the intestinal mucosa, as well as hemosiderosis of the lymph nodes, giving them a dull color. With a moderate degree of radiation sickness, pathological changes are less noticeable, with a mild degree - rare [13].

During radiometric control of each carcass, if a small piece of meat is cut from the most contaminated areas, and in a large batch - 10% of the carcass, a layer of meat 0.5 cm thick is cut off. The cut parts are placed with the contaminated sides on top of each other, packaged and sent to the laboratory. If the radioactive contamination of the carcass exceeds the maximum permissible level, the use of meat for food purposes is prohibited [14]. With internal radionuclide contamination, burns of the entire mucous membrane of the gastrointestinal tract can be observed. During veterinary and sanitary inspection of the carcass and organs of such animals, intracavitary radioactivity is determined by the method of laboratory radiometry. If the carcasses and organs are obtained from animals killed before the appearance of clinical signs of radiation sickness, do not have pathological changes requiring samples to be sent for bacteriological examination, and their specific radioactivity is equal to or lower than the level of radioactive contamination of food products, they are used. There are no restrictions. If pathological changes are detected, samples are sent to a veterinary laboratory, taking into account the results of bacteriological analysis. When using a carcass, if radioactive contamination exceeds the established value, the carcass and organs are not removed. Depending on the conditions, they are stored until the radioactivity decreases, subjected to treatment that reduces radioactive contamination (rendered, salted, etc.), processed into feed additives or destroyed. In case of radiation damage to animals, the protective and barrier functions of the body are sharply suppressed: natural and acquired immunity weakens, the barrier properties of the lymph nodes and the antitoxic function of the liver decrease, the activity of macrophages decreases [15], the intensity of antibody formation decreases, the permeability of the skin and mucous membranes decreases, bactericidal properties decrease, and

the inflammatory response to the penetration of microbes is disrupted. In the process of developing radiation damage, increased permeability and fragility of capillaries lead to the occurrence of profuse bleeding of various localizations and sizes.

At present, the susceptibility of various irradiated animals to pathogenic and opportunistic microbes has been established using various infectious disease pathogens and typical representatives of the intestinal and respiratory microflora. It has been proven that external exposure to ionizing radiation at a dose of 5.0-6.0 g on sheep, calves and pigs - carriers of salmonella leads to intensification and generalization of the salmonellosis process.

Thus, the constantly developing endogenous infection and increased susceptibility of the irradiated organism to pathogenic microbes should be taken into account during the veterinary and sanitary examination of carcasses and organs of radiation-affected animals.

Radiation injuries of animals are accompanied by metabolic disorders, in particular carbohydrate metabolism. In affected animals, an increase in blood sugar levels is observed within a few hours after irradiation, which is of the greatest importance in the development of radiation sickness. The higher the dose of ionizing radiation, the higher the hyperglycemia in animals. The duration of hyperglycemia is from 2 to 3 weeks. By this time, clinical signs of radiation injury appear in the liver, and a sharp decrease in glycogen content is observed. During the maturation period of meat, the work of glycolysis enzymes, i.e. glycogen breakdown, is especially enhanced. Glycogen, through a series of intermediate reactions, is converted into lactic acid, which plays an important role in the process of meat maturation. The accumulation of lactic acid in muscle tissue is one of the factors that increases the concentration of hydrogen ions. A more acidic reaction of the environment contributes to the creation of unfavorable conditions for the development of putrefactive microflora. It is natural that a violation of carbohydrate metabolism in irritated animals leads to a change in the process of meat maturation [16].

The minimum toxic doses of the main products of radioactive decay for animals are almost 100-1000 times higher than the dose of radioactive substances, the same amount of radioactive elements accumulate in milk and meat, making these products unfit for consumption. During the observation period, it was established that a single irradiation with iodine-131 at a dose of 5-6 μCi/kg of body weight did not lead to changes in thermoregulation, the cardiovascular system, respiratory and digestive organs, leukocytes, erythrocytes and hemoglobin. However, almost three weeks after contamination, the milk from these cows turned out to be unfit for consumption, since the amount of iodine-131 in it exceeded the maximum permissible concentration by 3 times. The meat and carcasses of cows slaughtered on the 23rd day after infection cannot be consumed, as they contain iodine-131, an isotope whose concentration in muscles exceeds the permissible level by 2 times, in the liver by almost 9 times, and in the liver by 11 times [14].

2. Results and Discussion

It follows from the above that when pastures or feed are contaminated, radioactive substances accumulate in milk and meat in quantities dangerous to humans, clinical signs of radiation sickness begin to appear, and animal productivity decreases. Therefore, in this case, the main attention should be paid to predicting and determining the level of radioactive contamination of livestock products obtained from animals exposed to radioactive substances. Therefore, when determining the standards for the maximum permissible concentration of radioactive decay products in feed, it is assumed that the level of accumulation in livestock products does not exceed the permissible amount of radioactive

isotopes entering the human body over a certain period of time in accordance with current sanitary rules.

The maximum permissible levels of the intake of the main decay radionuclides into the body of animals for the purpose of obtaining radiation-hygienically safe products from animals are given and presented. The content of cesium-137 and strontium-90 isotopes in the organs and tissues of young Buzur breed sheep, studied using the controlled testing method, is presented in Table 1. The presented data show that the amount of radionuclides in the organs and muscle tissue of young animals is several times lower than their maximum concentration in meat products. Table. Content of cesium-137 and strontium-90 isotopes in the organs and tissues of the sheep studied.

Analysis and generalization of the main patterns of distribution, accumulation and migration of radioactive substances in the body of farm animals allows us to obtain practical recommendations for the veterinary and sanitary assessment of carcasses and organs of animals exposed to radioactive substances.

Table 1. amount of radionuclides in the organs and muscle tissue of young animals is several times

Organs and tissues	Not exceeding the permitted level of contamination Bq/kg		The amount of radionuclides given the age of sheep Bq/kg.					
			cesium – 137			strontium - 90		
	cesium – 137	strontium – 90	2 months	4 months	6 months	2 months	4 months	6 months
Kidneys	160	50	4	4	16	4	5	54
Liver			3	4	14	4	5	8
Lungs			3	4	14	4	6	11
Heart			4	4	15	4	5	7
Muscles			2	3	11	3	4	5

3. Conclusion

Based on the above, the following conclusions can be made:

- carcasses and organs of animals exposed to radioactive substances and died shortly after exposure, in the absence of clinical signs of radiation sickness and pathological changes, require samples to be sent for bacteriological examination if their radioactivity, according to radiometric data, is equal to the permissible level of contamination with radioactive substances. The product can be used without restrictions at its level or below. After slaughter, the stomachs and intestines of such animals are repeatedly washed with water, and after radiometric examination, a decision is made on their use.
- the results of biochemical studies of the meat of rabbits, sheep, pigs, slaughtered at different times after exposure to ionizing radiation, confirmed that the depth and maturity of their meat depend on the degree of radiation exposure and the time of slaughter. The meat of animals with a mild degree of radiation sickness matures like the meat of healthy animals. When storing the meat of animals with a

high degree of radiation sickness under the same conditions, the depth and maturity of the meat of animals slaughtered 2 days after the attack correspond to the maturation of the meat of healthy animals. The next day after the attack changes. When stored for 2-3 days, the pH level of such meat is 6.3-6.4; according to sanitary and hygienic indicators, the meat of heavily affected and slaughtered animals is less stable when stored for 5-7 days, and its poor quality appears 2-3 days earlier than that of the meat of healthy animals. This phenomenon is explained by the fact that the meat is not cooked enough, since its environment has a reaction close to neutral, which is favorable for the development of putrefactive microbes. According to some data, sausages made from the meat of irradiated pigs killed during the latent period of radiation damage, spoil much faster during long-term storage than sausages made from the meat of healthy pigs. Carcasses and organs in which pathological changes are not detected, but the level of radioactive contamination exceeds the established one, are not removed for food purposes and, depending on the existing conditions, are stored in separate refrigerator chambers until the radioactivity decreases to the maximum level or has a technological effect. To reduce radioactive contamination, various processing methods are used and radiometry is repeated.

If pathological changes equal to or below the permissible level of radioactivity are detected in the carcass and organs, the question of their use is decided taking into account the results of bacteriological studies. If bacteria of the paratyphoid group, E. coli, coccal microflora, especially microbes of the Proteus group are detected in the organs, lymph nodes or muscles, the carcass is rendered harmless by boiling. During the cooking of contaminated meat, more than half of the radioactive substances introduced into it end up in the broth. Upon completion of the rendered harmless, the meat is subjected to repeated radiometric examination. If the radioactive contamination of the carcass is 2 times higher than the permissible level, it is impossible to reduce its specific radioactivity to the maximum permissible value by boiling the meat, therefore the contaminated meat is stored in separate freezers, or salted, or destroyed, depending on the available possibilities, to reduce the amount of radionuclides. Veterinary and sanitary examination of carcasses and organs of poultry located in areas contaminated with radioactive substances is carried out in accordance with the current inspection rules and taking into account the results of radiometric studies. Stomachs and intestines are removed. If radioactive contamination of carcasses or organs exceeds the maximum permissible level, the internal organs are destroyed, and the carcasses are stored until the radioactivity decreases below the permissible level. If contamination with cesium-137 or strontium-90 exceeds the permissible level, the carcasses of poultry are subject to destruction.

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