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DESCRIPTION OF THE DYNAMICS OF MORPHOLOGICAL CHANGES IN THE LIVER AND INTESTINES OF LABORATORY ANIMALS UNDER ACUTE RADIATION

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Abstract. The aim of the study was to describe the dynamics of the morphological changes in the liver and small intestine of laboratory animals during acute radiation in the biocorrection state. It was found that significant morphological changes were observed in the liver of laboratory animals after acute radiation in both groups, and the intensity of morphological changes was lower in group 2 with prior biocorrection than in group 1 without biocorrection. A similar situation was observed when studying the histological picture of the small intestine of these white-bred rats, the intensity of morphological changes was lower than in white-bred rats that did not receive the biologically active supplement "Lactopropolis-AWL".
Key words: acute radiation, liver and small intestine of laboratory animals, morphological changes, biocorrection.

Relevance. Acute radiation depends on the frequency and duration of ionizing radiation and develops in different degrees depending on the radiation sensitivity of the organs. The most sensitive organs in acute radiation are immune system organs (thymus, bone marrow, spleen, lymph nodes), mucous membranes of the gastrointestinal tract, exo- and endocrine glands (pituitary gland, thyroid gland, adrenal gland), gonads (ovary, testicle, prostate gland). Organs that are less sensitive to radiation include the heart, kidney, liver, brain and spinal cord, bone tissue, and joints [2].

In the course of radiation, the membrane of biological tissues becomes destabilized: an increase in membrane permeability leads to the activation of proteins located freely in the cytoplasm, damage to the intracellular structures of lysosomal enzymes, and the development of hydropic dystrophy in the epithelia of kidney tubules due to the large influx of liquid and various micro- and macroelements, including calcium ions, into the cell. [3, 10].

Hepatocyte hypoxia due to venous congestion in the liver tissue leads to the development of fatty dystrophy with large, medium and small droplets [5].

The aim of the study was to describe the dynamics of the morphological changes in the liver and small intestine of laboratory animals in the state of biocorrection during acute radiation.

Material and methods. For experimental studies, 60 white male rats weighing 160-180 g were selected. All laboratory animals were obtained from the same vivarium and were of the same age. All were kept in standard vivarium conditions (temperature 21-220C, humidity 50-60%, light regime 12 hours light and dark). Feeding, care of laboratory animals in vivarium conditions, compliance with biological safety rules and ethical principles when working with them N.A. Nuraliev. and all. It was done according to [1, 6].

All laboratory animals were divided into the following groups:

Group 1 - non-biocorrected non-biocorrected white rats (n=15) on a standard vivarium diet, receiving a single acute radiation in the amount of 5 Gray;

Group 2 - non-white rats that received a single acute radiation in the amount of 5 Gray, and biologically active supplement "Lactopropolis-AWL" was added to the standard vivarium ration as a biocorrection (n=15);

Group 3 - intact non-white rats (n=30) on a standard vivarium diet that did not receive acute radiation.

In the experiment, laboratory animals were irradiated using the AGAT-R1 (Estonia) gamma-therapeutic apparatus, in which the source of radiation was So-60. Animal irradiation studies were conducted at the Bukhara Branch of the Republican Specialized Oncology and Radiology Center of the UzR SSV.

Lactopropolis-AWL was given to all laboratory animals every morning based on their weight. Acutely irradiated subjects were dosed for 20 days, irradiated on the last day, and then euthanized on day 5 for morphological studies.

"Lactopropolis-AWL" biologically active supplement consists of extracts of Lactobacillus rhamnosus 925, Enterococcus durans probiotic bacteria and biologically active compounds of propolis and has antimicrobial, immunostimulating, anti-inflammatory properties (a product of the Institute of Microbiology of the Russian Federation FA and "AllWellLab" LLC).

Methods widely used in experimental studies were used to study the morphological parameters of the liver and small intestine of laboratory animals (anatomical dissection). All biological micro-objects were viewed using an HL-19 model trinocular microscope (China) with software. The preparation of histological preparations made from the liver and small intestine of purebred rats consisted of 4 stages and was carried out by traditional methods. A YD-315 mechanical rotary microtome (China) was used to prepare the preparations, the prepared sections were stained with hematoxylin-eosin. Photographing of micropreparations was carried out under a microscope at dimensions 4x10, 10x10, 20x10, 40x40, 60x10, 80x10.

Statistical processing of the obtained material was carried out directly using the general data matrix "Excel 7.0". Statistical processing of the obtained data was carried out by calculating the following parameters: arithmetic mean (M), arithmetic mean error (m), standard deviation, confidence interval. Principles of evidence-based medicine were used in the organization and conduct of the study.

Results and their discussion. As a result of various internal and external influences, changes in the structure of the liver along with its functional state have been found. Because the radiation-induced changes are comparatively less studied, the morphological features of the acute radiation-induced liver were studied and analyzed.

Since the morphology of the liver of intact laboratory animals is presented in many scientific studies [9], we did not mention the morphological structure of the liver within the norm.

The obtained results showed that in all the laboratory animals of group 1 (100.0%, n=15) it was found that the lobular structure of the liver tissue did not change against the general background, and the triad vein was completely visible (100.0%, n=15) (1- picture).

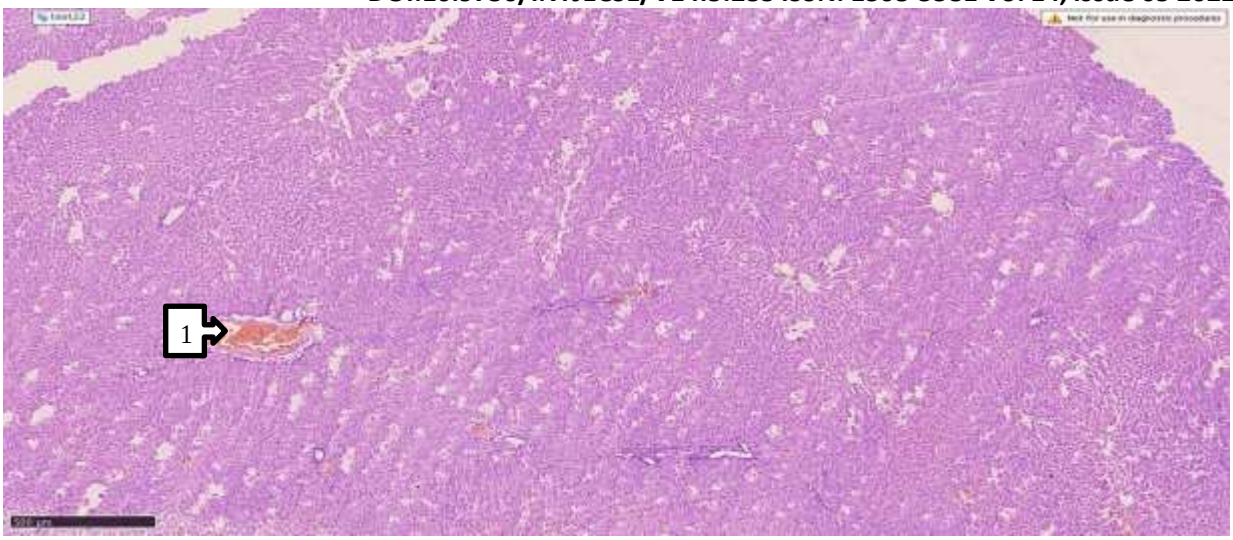

Figure 1. Histological appearance of the liver of a non-white breed rat that received acute radiation (the liver tissue has not changed in its lobular structure against the general background, the triad vein is complete in appearance (1). Stained with hematoxylin-eosin, 4x10).

When the histological preparation prepared from the liver of another non-white rat from the same group was examined under a microscope, foci of fatty dystrophy were detected in the hepatocytes around the triads in the liver (86.7%, n=13), as well as the expansion of the sinusoidal spaces around the central vein (86.7%, n=13). Figure 2).

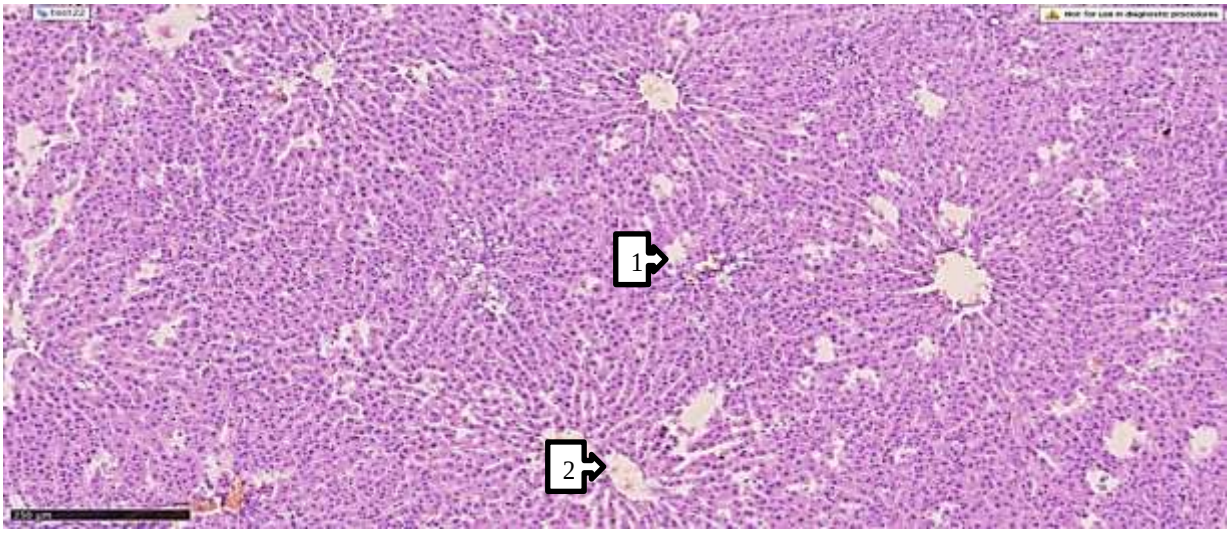

Figure 2. Histological appearance of the liver of a white breed rat that received acute radiation (fatty dystrophy foci are detected in the hepatocytes around the triads (1). The sinusoidal spaces around the central vein are enlarged (2). Stained with hematoxylin-eosin, 10x10).

In another histological preparation, the results of the study of Kupffer cells in the liver of laboratory animals belonging to this group are presented. It is known that Kupffer cells are formed from circulating bone marrow monocytes, make up 20% of the cells in the liver, are located in the sinusoids of the liver and are attached to the sinusoidal endothelial cells that form the wall of blood vessels [8]. It was found that Kupffer cells migrated around the triads (80.0%, n=12), large steatohepatocytes were detected around the periportal veins (86.7%, n=13). Their detection

indicated that an inflammatory process is taking place in the liver against the background of fatty dystrophy. It was also observed that there were many foci of monocellular necrosis (73.3%, n=11) in hepatocytes (Figure 3).

Monocellular necrosis (cellular - fat) - necrosis of a fat cell. often seen in the liver, the cause is fatty necrosis in the liver.

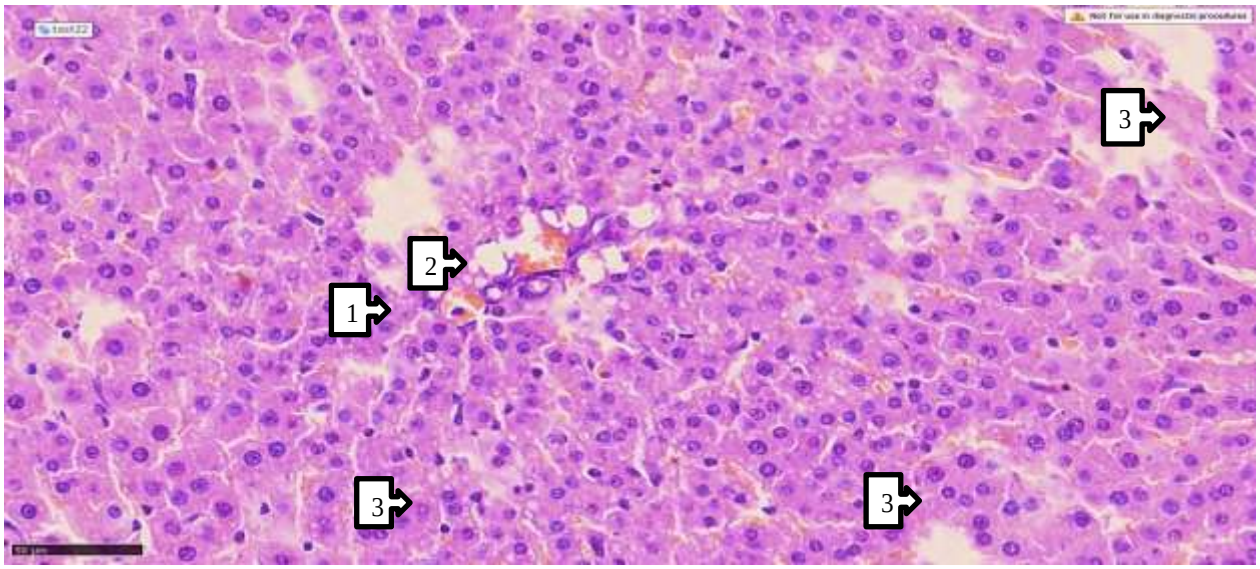

Figure 3. Histological appearance of the liver of a white breed rat that received acute radiation (Kupffer cells migrated around the triads (1), large steatohepatocytes around the periportal veins (2), numerous monocellular necrosis foci were detected in the hepatocytes (3). Stained with hematoxylin-eosin. 40x10.)

Continuing to study the histological preparations, one of them revealed hepatocytes with a large fat drop in the focus, the nuclei shifted to the periphery, while a focal focus of hepatocytes with hydropic dystrophy (66.7%, n=10) was also observed, and the rest of the hepatocytes suffered from medium and small fatty dystrophy. It is known that hydropic dystrophy is the appearance of vacuoles filled with cytoplasmic fluid in hepatocytes. Perisinusoidal spaces (spaces of Disse) are of different widths (Fig. 4), and in the visual field they are almost not detected (93.3%, n=11).

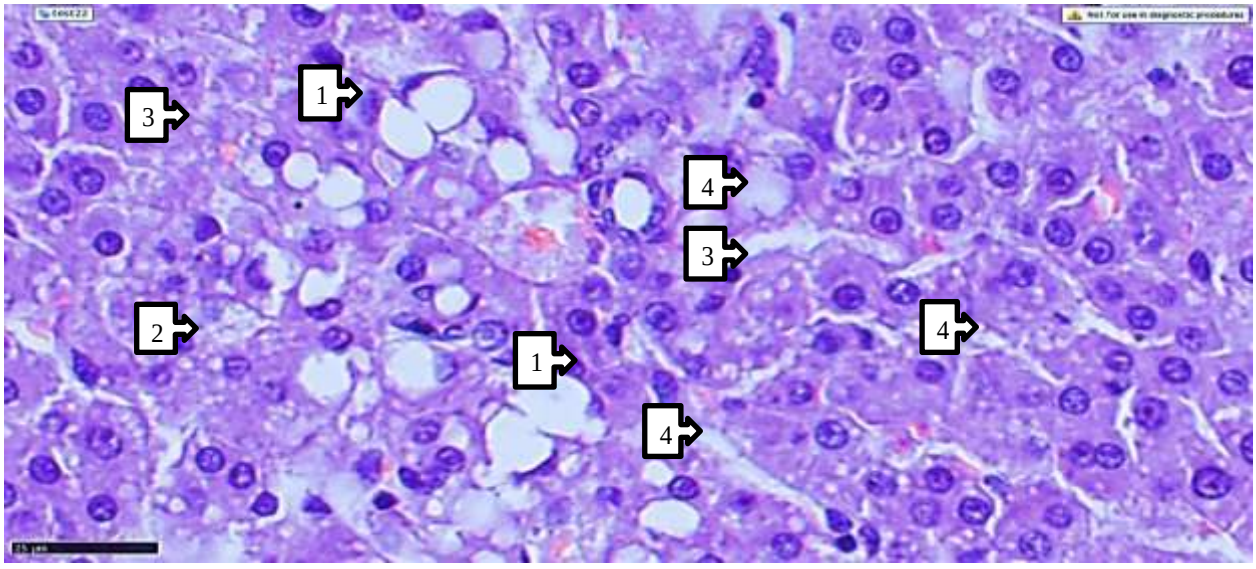

Figure 4. Histological appearance of the liver of a white breed rat that received acute radiation (hepatocytes with large fat droplets in the focus, nuclei shifted to the periphery (1),

focal focus of hydropic dystrophy hepatocytes (2), medium and small fatty dystrophy hepatocytes (3), sinusoidal spaces of different widths (4), spaces of Disse were almost not detected. Stained with hematoxylin-eosin. 80x10).

Perisinusoidal spaces (spaces of Disse) are narrow spaces between the walls of hepatocytes and sinusoidal capillaries in the liver lobe, the width of which is 0.2-1.0 μm. In the space of Disse, there is an exchange of substances between hepatocytes and blood plasma, and it should be mentioned that Ito cells, which participate in fibrogenesis, are also located in this space [7].

In the following histological preparation of the liver of white rats exposed to acute radiation, the migration of Kupffer cells around the periportal vein blood vessel (80.0%, n=12) and the phagocytosis of necrotic hepatocytes by Kupffer cells (66.7%, n=10) were observed.

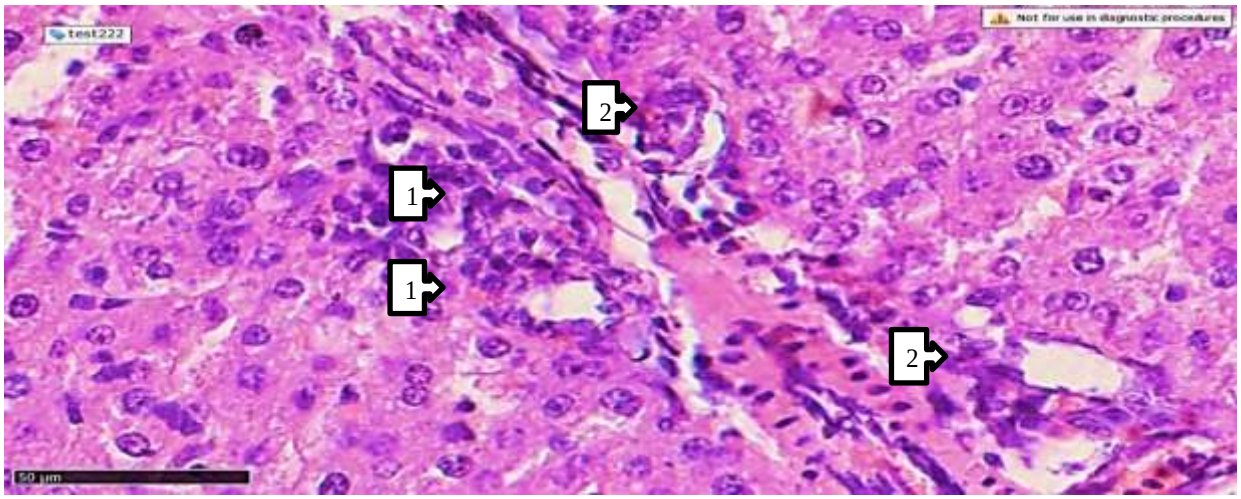

Figure 5. Histological appearance of an acutely irradiated albino rat liver (migration of Kupffer cells around the periportal vein blood vessel (1), necrotic hepatocytes undergoing phagocytosis by Kupffer cells (2). Stained with hematoxylin-eosin. 80x10).

When studying the histological appearance of the liver of purebred rats that received the biologically active supplement "Lactopropolis-AWL" before acute radiation, it was found that in most of them the liver tissue and capsule were of the same thickness, reparative regeneration was clearly described in the subcapsular hepatocytes, and the lobular structure did not change (100.0%, n =15). Uneven fullness in central veins, expansion of sinusoidal spaces around them was detected in a small amount (26.7%, n=4) (Fig. 6).

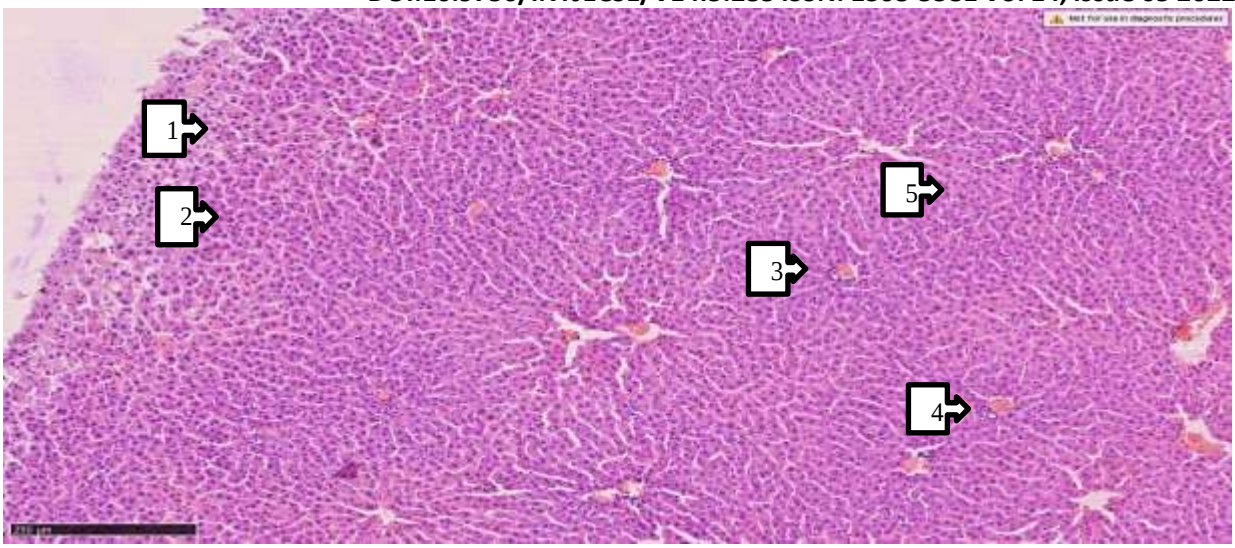

Figure 6. Histological appearance of the liver of a purebred white rat that received the biopreparation before acute radiation (liver tissue, capsule of the same thickness (1), reparative regeneration in subcapsular hepatocytes (2), lobular structure unchanged (3), uneven fullness in central veins (4), sinusoidal around trada spaces are enlarged (5). Stained with hematoxylin-eosin, 4x10).

When studying the morphological (histological) appearance of the liver of another white breed rat belonging to this group, uneven filling of the liver tissue, central vein, monocellular necrosis in centrolobular hepatocytes (53.3%, n=8), foci of attenuated droplet-shaped fatty dystrophy in hepatocytes from the top left in Figure 7 (46.7%, n=7) was found (Fig. 7). As can be seen from the obtained results, the intensity of negative morphological changes in the liver of purebred rats was less in group 2 than in group 1.

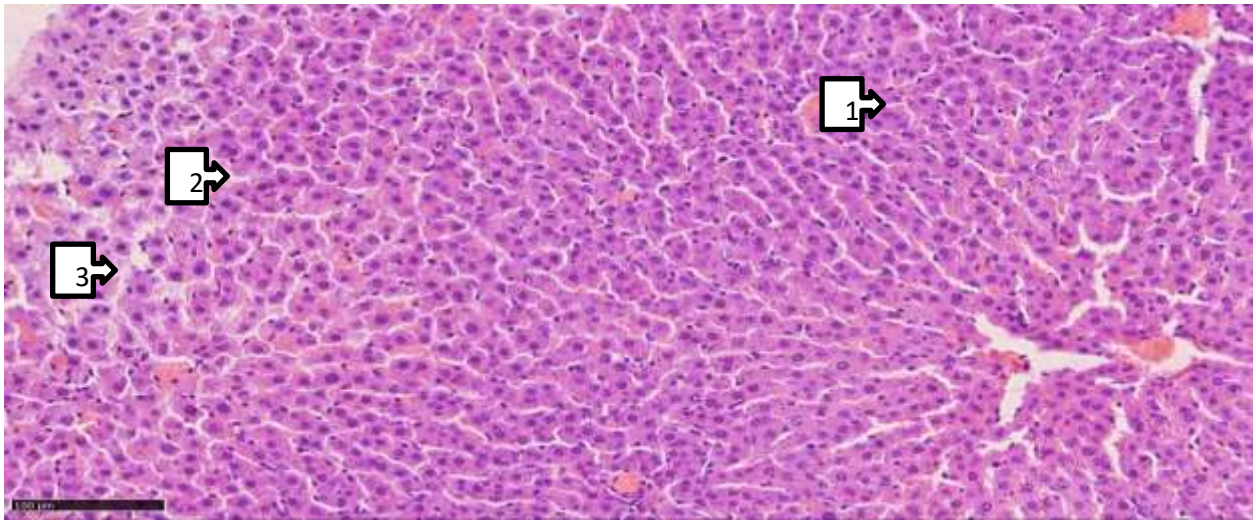

Figure 7. Histological appearance of the liver of a purebred rat that received the biopreparation before acute irradiation (liver tissue, uneven filling in the central vein (1), monocellular necrosis in centrolobular hepatocytes (2), foci of dystrophy with slowly formed hyaline drops in hepatocytes from the top left (3). Staining G-E 10x10.

Similar results were observed in the livers of other nonwhite rats belonging to group 2. For example, in the considered histological preparation (Fig. 8), migration of Kupffer cells around the triads (60.0%, n=9), increased apoptosis and deformed nuclei in dystrophically changed

hepatocytes (60.0%, n=9), narrowed sinusoidal spaces (66.7%, n=10) and fullness was observed in periportal veins.

In order to compare with laboratory animals that did not receive biopreparation before acute radiation (group 1), we note that the following changes in the morphological characteristics of the liver of animals belonging to group 2 decreased in intensity: "capillarization process" or "phenomenon of capillarization of sinusoids" around hepatocytes (60.0% . , n=10).

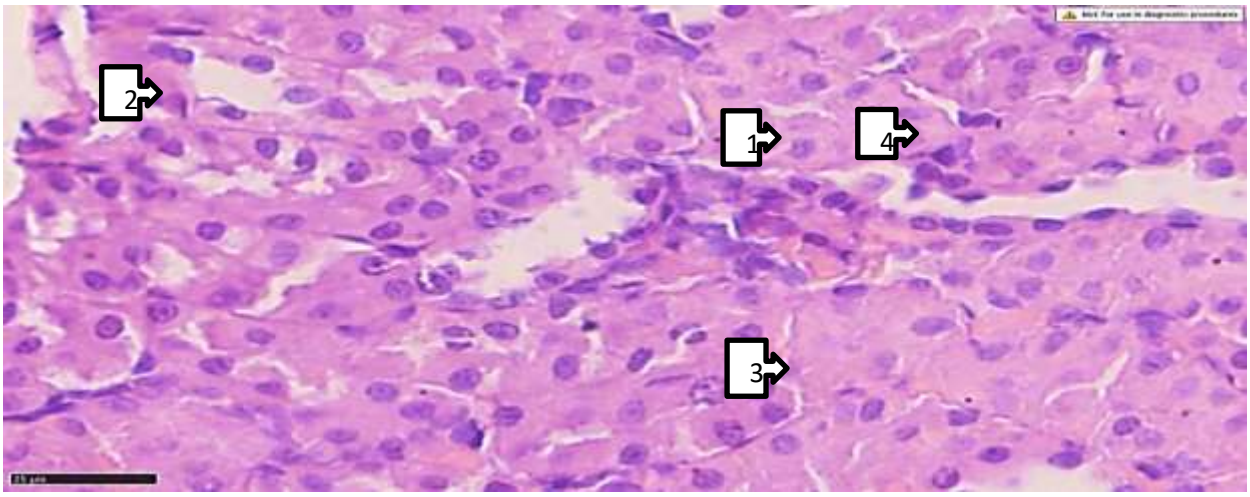

Figure 8. Histological appearance of the liver of a purebred rat that received the biopreparation before acute radiation (migration of Kupffer cells around the triads (1), increased apoptosis and deformed nuclei in dystrophic hepatocytes (2), narrowed sinusoidal spaces (3), fullness in the periportal vein (4). Stained with hematoxylin-eosin, 40x10).

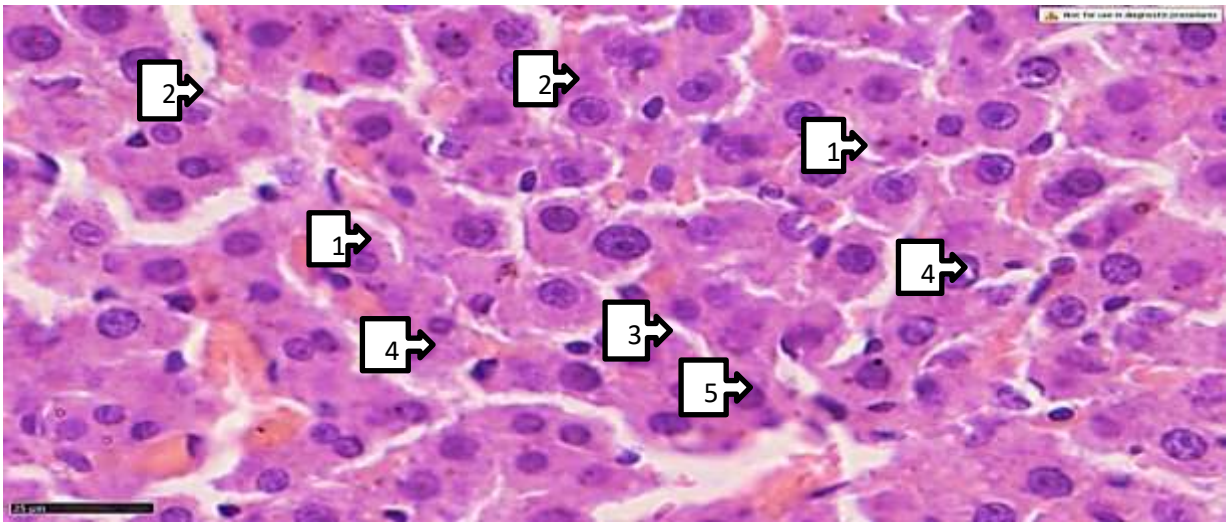

Figure 9. Histological appearance of the liver of a purebred rat that received the biopreparation before acute radiation ("capillarization process" around hepatocytes (1), the nucleus of hepatocytes is hyperchromic (2), the reparative regeneration process is enhanced (3). Sinusoidal spaces are of the same width around hepatocytes (4), in hepatocytes expansion of sinusoidal spaces in the necrotic area (5). Stained with hematoxylin-eosin, 80x10).

It is known that the closure of the functional intercellular space, where the exchange of substances between hepatocytes and the blood entering from the portal vein system takes place, is called the "capillarization process" or the "phenomenon of sinusoid capillarization", in which hypoxia develops and the process of fibrogenesis develops.

All obtained data were summarized and compared between groups (Table 1).

Table 1

Comparative indicators of morphological changes in the liver of acutely irradiated purebred rats

Morphological parameters	Biocorrected (n=15)	Not biocorrected (n=15)
Liver tissue is fragmented, its structure has not changed	15 / 100,0	15 / 100,0
The sinusoidal spaces around the central vein are enlarged	13 / 86,7	4 / 26,7
There are foci of moncellular necrosis	11 / 73,3	8 / 53,3
There are foci of fatty dystrophy in hepatocytes	13 / 86,7	7 / 46,7
There is migration of Kupffer cells around the triads	12 / 80,0	9 / 60,0
Disse spaces are of different widths	14 / 93,3	10 / 66,7

Note: the figure shows absolute numbers, and the denominator shows relative (%) numbers.

As can be seen from the obtained results, significant morphological changes were observed in the livers of laboratory animals after acute radiation in both groups, and the intensity of morphological changes was lower in group 2, which was previously biocorrected. Therefore, the morphological changes of the liver were not evident in all animals under the influence of acute radiation in white rats that received the biologically active supplement "Lactopropolis-AWL", which, in turn, testified to the effectiveness of this biopreparation and became the basis for recommending it for preventive biocorrection purposes.

At the next stage of our work, liver studies were conducted in the small intestine of non-white rats that did not receive the biopreparation (group 1) and received the biopreparation ("Lactopropolis-AWL" biologically active supplement) (group 2).

It was found that the histological structure of the small intestine was unchanged, and the villi of the mucous membrane were the same (100.0%, n=15) in the white non-breed rats belonging to the first group (Fig. 10).

Figure 10. Histological appearance of the small intestine of a nonwhite rat that received acute radiation (histostructure is unchanged, mucosal villi are uniform in appearance. Stained with hematoxylin-eosin, 4x10).

When another histological preparation was studied, foci of necrosis of mucocytes were detected on the surface of the villi of the mucous membrane of the small intestine of white rats that received a single acute radiation (66.7%, n=10), it was shown that hyperplastic changes were slowly formed in the germinal area of the Malt structure (53.3%, n =8), the serous membrane was of different thickness.

It is known that goblet cells (mucocytes), which are one of the types of enterocytes, make up 9.5% of epithelial cells. These cells accumulate mucinogenic granules, which in turn swell by absorbing water and turn into mucin. Therefore, it is important to study and evaluate the structure, morphological state of mucocytes [4].

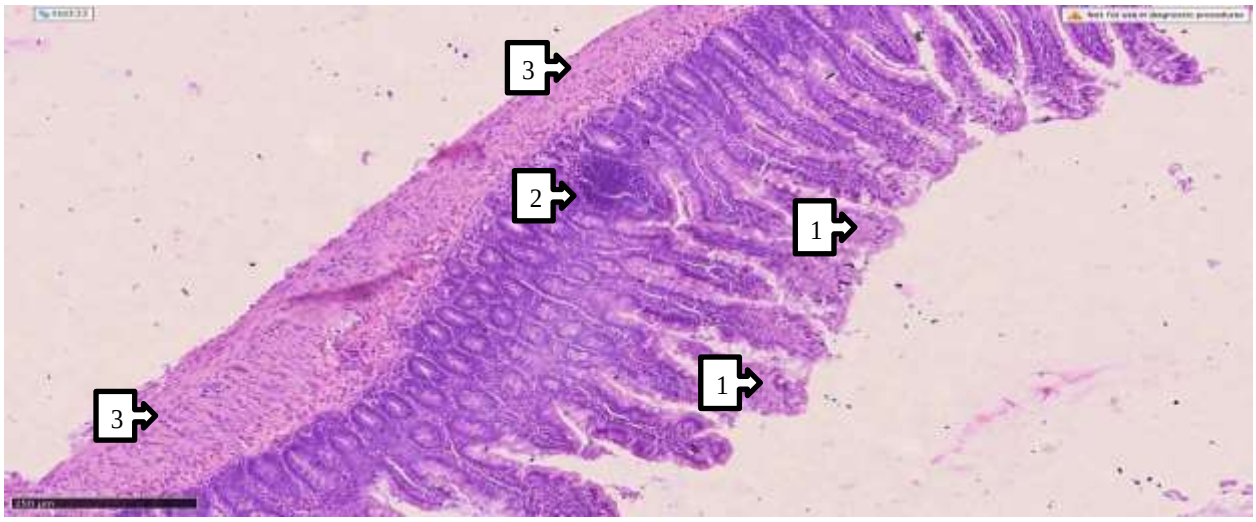

Figure 11. Histological appearance of the small intestine of a white non-breed rat that received acute radiation (many mucocytic necrosis foci were detected on the surface of the villi of the small intestine mucosa (1), hyperplastic changes were slowly formed in the germinal area of the Malt structure (2), the serous membrane was of different thickness (3). Hematoxylin-eosin painted with, 10x10)

In another histological preparation, in the field of view (Fig. 12), it was found that the goblet cells located in the villi of the small intestine were of different sizes, there were many foci of focal necrosis in the mucocytes (66.7%, n=10), foci of fibrinoid swelling were observed in the stroma of the muscle layer (46.7 %, n=7).

At the same time, slow proliferation was observed in the lymphocytes located in the lymphoid follicle of the small intestine (80.0%, n=12), anemic foci were detected in the parafollicular capillaries (86.7%, n=13), hypersecretion and cytoplasm in the gland cells around the follicle in the mucosa. It was found that the basophil was stained (Fig. 13).

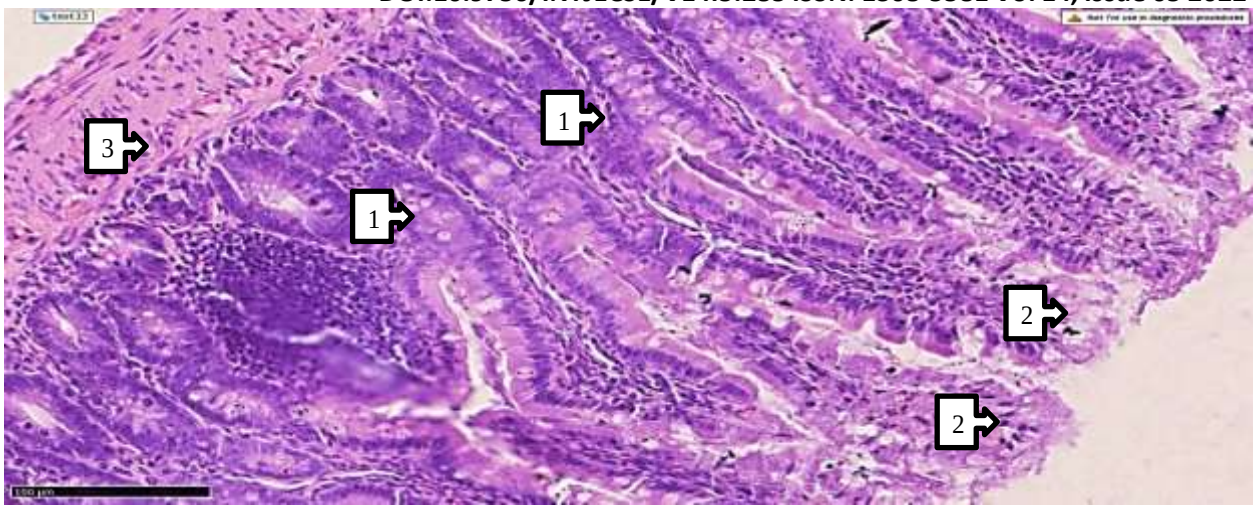

Figure 12. Histological appearance of the small intestine of a purebred rat that received acute radiation (goblet cells in the villi of different sizes (1), many focal necrosis foci in mucocytes (2), foci of fibrinoid swelling in the stroma of the muscle layer (3) were detected. Stained with hematoxylin-eosin. 40x10) .

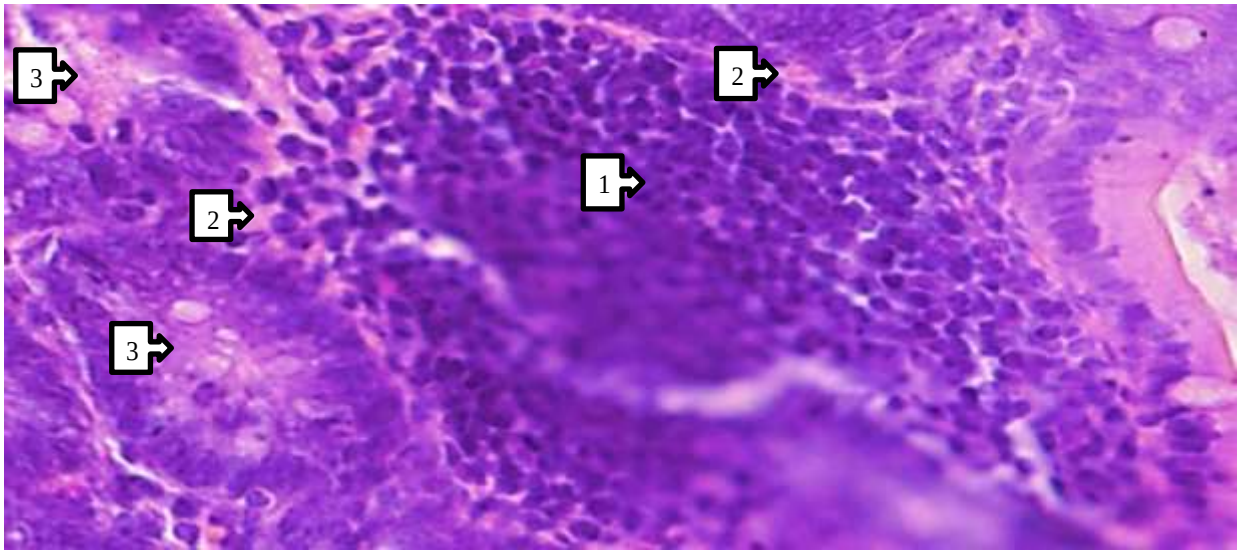

Figure 13. Histological appearance of the small intestine of a white non-breed rat that received acute radiation (slowly developed proliferation of lymphocytes in the lymphoid follicle of the small intestine (1), anemic foci in the parafollicular capillaries (2), hypersecretion in the gland cells around the follicle, and basophilic staining of the cytoplasm (3). Stained with hematoxylin-eosin. 80x10).

In another histological preparation stained with hematoxylin-eosin, mucocytes were evaluated (Figure 14). It was found that the proliferation of fibroblasts developed in the stroma of the villi (66.7%, n=10), dystrophic and necrotic foci were detected in the secretory cells (53.3%, n=8), necrotic erosive changes were detected in the mucocytes on the surface of the villi (53.3% , n=8).

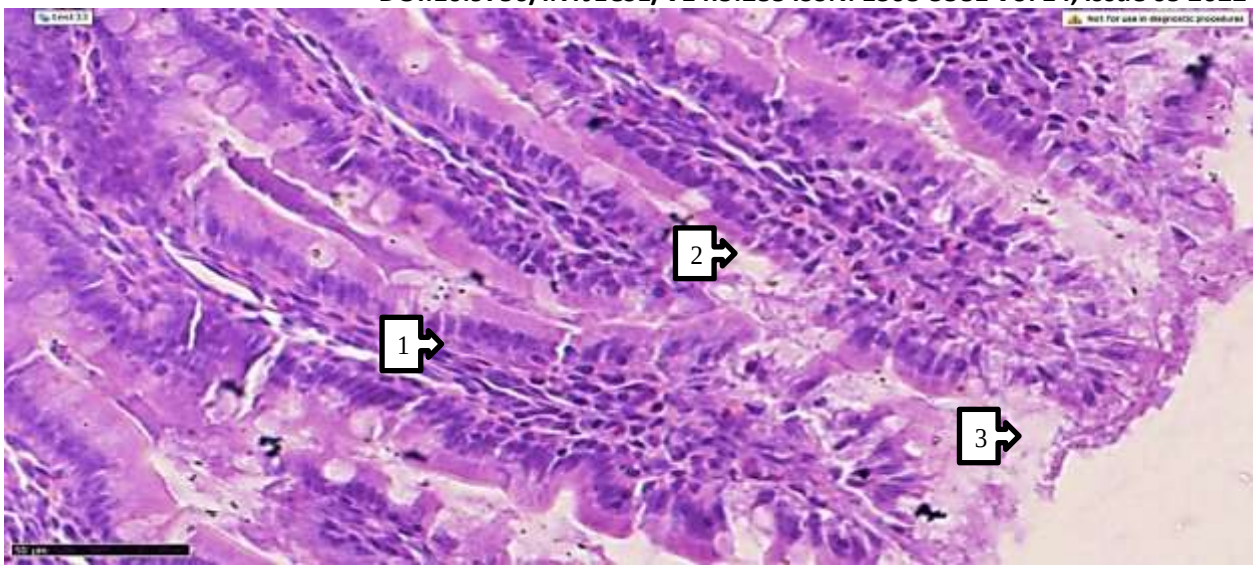

Figure 14. Histological appearance of the small intestine of a white non-breed rat given acute radiation (proliferation of fibroblasts developed in the stroma of the villi (1), dystrophic and necrotic foci in the secretory cells (2), necrotic erosive changes were detected in the mucocytes on the surface of the villi (3). Stained with hematoxylin-eosin. 40x10).

Thus, significant morphological changes were detected in the small intestine of white rats that received acute radiation. The above-mentioned changes in the small intestine of these laboratory animals, which were fed only vivarium diet without biological preparation, were evaluated as an acute radiation effect.

The histological picture of the small intestine of non-white rats receiving the appropriate dose of biologically active supplement "Lactopropolis-AWL" once a day before acute irradiation was also studied.

These rats were euthanized, and when histological preparations prepared from their small intestine were studied, it was observed that the histioarchitectonics of the small intestine did not change, and the villi were of the same size (Fig. 15).

In this case, there were no practical changes in both groups, and no statistically significant differences were found in morphological characteristics.

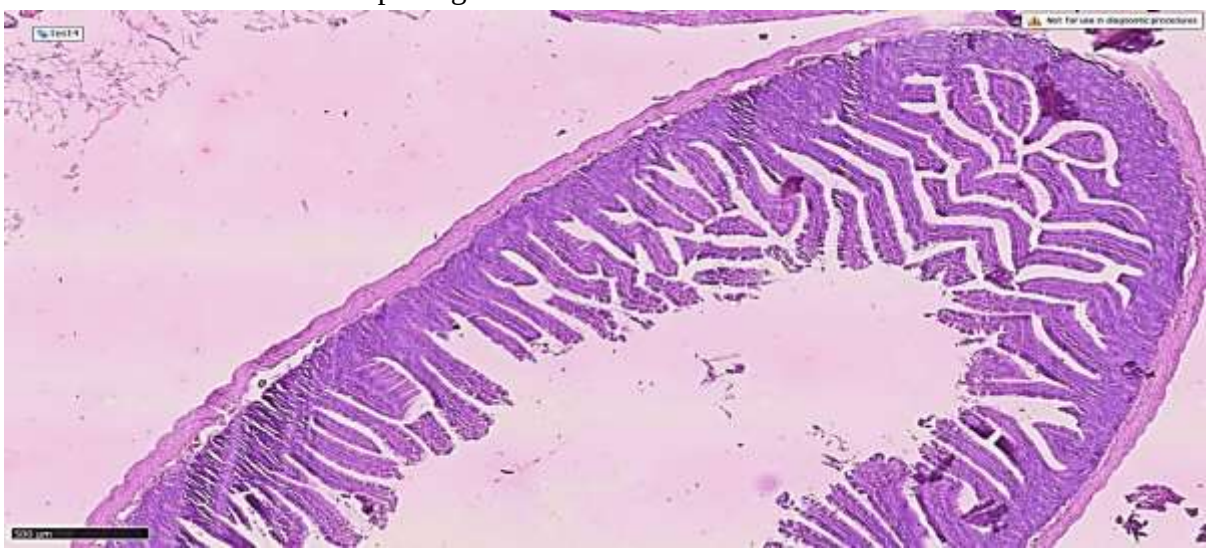

Figure 15. Histological view of the small intestine of a white non-breed rat treated with the biopreparation before acute irradiation (the histioarchitectonics of the small intestine is unchanged, the villi are of the same size. Stained with hematoxylin-eosin. 4x10).

In another laboratory animal belonging to this subgroup, the villi of the small intestine were full (Fig. 16), interstitial edema in the stroma (33.3%, n=5), blood vessels of the mucous membrane were full (33.3%, n=5).), uneven interstitial swellings were detected in the serous membrane (46.7%, n=7).

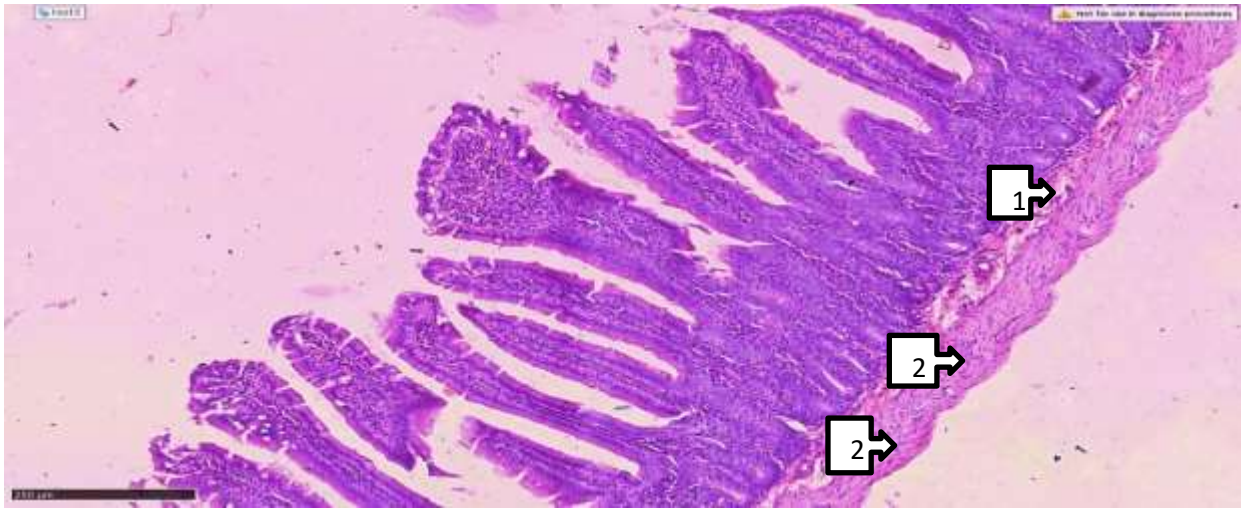

Figure 16. Histological appearance of the small intestine of a white non-breed rat treated with biopreparation prior to acute irradiation (small intestinal villi are full, interstitial swellings in the stroma, blood vessels of the mucous membrane are full (1), uneven interstitial swellings are detected in the serous membrane. Stained with hematoxylin-eosin. 10x10).

As it is known, intestinal villi (lat. villi intestinales) are outgrowths of the intestinal mucosa and are formed by finger-like or leaf-like protrusions of the mucous membrane, which are characterized by their free protrusion into the small intestine. The main function of the intestinal villi is to ensure the size of the absorption area of the mucous membrane. Due to these villi, the absorption surface of the small intestine increases 8-10 times [4].

In another histological preparation, foci of hydropic dystrophy were detected in the mucocytes on the surface of the villi (40.0%, n=6), and increased proliferation of fibroblasts in the stroma of the villi was observed (40.0%, n=6) (Fig. 17).

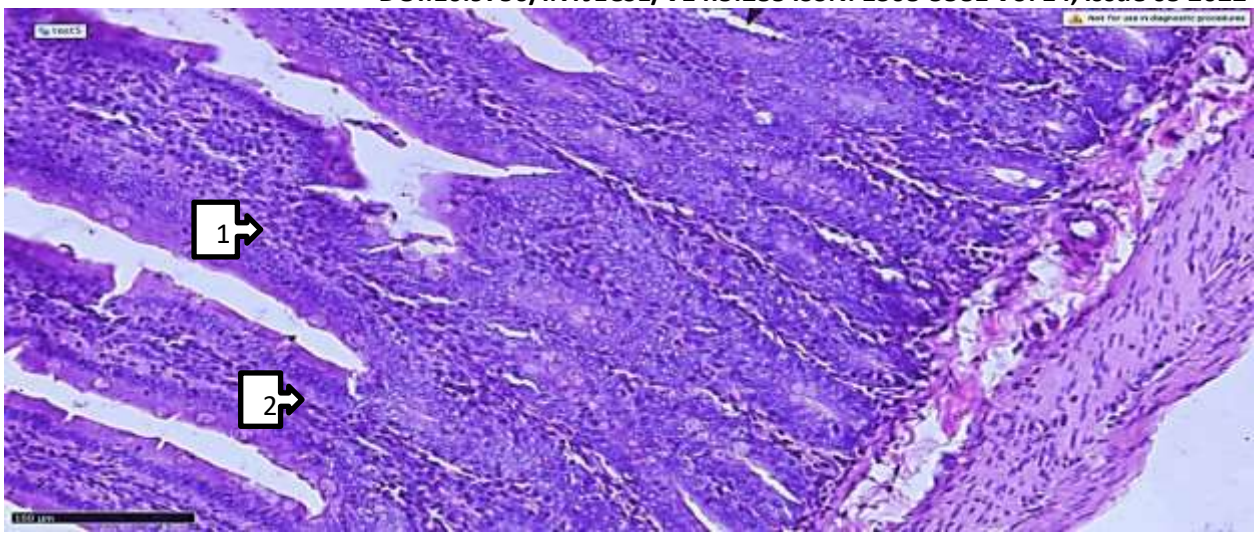

Figure 17. Histological appearance of the small intestine of a white non-breed rat treated with biopreparation before acute irradiation (foci of hydropic dystrophy were detected in the mucocytes on the surface of the villi (1), increased proliferation of fibroblasts in the stroma of the villi (2). Stained with hematoxylin-eosin. 10x10).

It is known from scientific sources that hydropic dystrophy (vacuolar dystrophy, watery dystrophy) is a tumor of parenchymatous cells, characterized by the appearance of vacuoles filled with cytoplasmic fluid inside the cell [4].

When the histological picture of the small intestine of the white rats that received the biologically active supplement "Lactopropolis-AWL" once a day until the acute irradiation was carried out, changes in the morphological characteristics of the small intestine were observed in most of them, but the intensity of these changes was dependent on the reception of the biologically active supplement "Lactopropolis-AWL". was lower than that of white outbred rats that did not. This situation is presented based on the numbers in Table 2.

Table 2

Comparative indicators of morphological changes in the small intestine of acutely irradiated white-bred rats

Morphological parameters	Biocorrected (n=15)	Not biocorrected (n=15)
The histological appearance is unchanged, the villi of the mucous membrane have the same appearance	15 / 100,0	15 / 100,0
There is an interstitial swelling in the stroma, uneven interstitial swellings in the serous membrane	10 / 66,7	7 / 46,7
Proliferation of fibroblasts increased (developed) in the stroma of villi.	10 / 66,7	6 / 40,0
Hydropic dystrophy in mucocytes	8 / 53,3	6 / 40,0
Poorly developed proliferation in lymphocytes	12 / 80,0	6 / 40,0
Focal, necrotic foci were detected in mucocytes	10 / 66,7	0 / 0

Note: the figure shows absolute numbers, and the denominator shows relative (%) numbers.

Conclusions.

1. Foci of fatty dystrophy in hepatocytes around triads (86.7%), expansion of sinusoidal spaces around the central vein (86.7%), migration of Kupffer cells around triads (80.0%) in the hepatocytes around the triads in the livers of group 1 white rats without biocorrection. , large steatohepatocytes (86.7%) were detected around the periportal veins. Their detection indicated that an inflammatory process is taking place in the liver against the background of fatty dystrophy.

2. In the histological preparations of the liver of animals of this group, numerous monocellular necrosis foci in hepatocytes (73.3%), focal foci of hepatocytes with hydropic dystrophy (66.7%) were also observed, Disse spaces were almost not detected in the visual field (93.3%).

3. Migration of Kupffer cells (80.0%), necrotic hepatocytes were phagocytized by Kupffer cells (66.7%, n=10) was observed around the periportal vein of the liver of white rats exposed to acute radiation.

4. When studying the histological appearance of the liver of purebred rats that received the biologically active supplement "Lactopropolis-AWL" before acute radiation, it was found that in most of them the liver tissue and capsule were of the same thickness, reparative regeneration was clearly described in the subcapsular hepatocytes, and the segmental structure did not change. Enlargement of sinusoidal spaces around the central veins was found in a relatively small number (26.7%, n=4).

5. In order to compare with laboratory animals that did not receive the biopreparation before acute radiation (group 1), the following changes in the morphological characteristics of the liver of animals belonging to group 2 decreased in intensity: "capillarization process" around hepatocytes (60.0%), most hepatocyte nuclei are hyperchromic (60.0%), the reparative regeneration process increased (93.3%), the sinusoidal spaces around the hepatocytes were of the same width (66.7%), and the expansion of the sinusoidal spaces was observed in the necrotic area of the hepatocytes (53.3%).

6. Significant morphological changes were observed in the liver of laboratory animals after acute radiation in both groups, and the intensity of morphological changes was lower in group 2, which was previously biocorrected. Therefore, the morphological changes of the liver were not evident in all animals under the influence of acute radiation in white rats that received the biologically active supplement "Lactopropolis-AWL", which, in turn, testified to the effectiveness of this biopreparation and became the basis for recommending it for preventive biocorrection purposes.

7. In white rats that received acute radiation, foci of necrosis of mucocytes were detected on the surface of the villi of the mucous membrane of the small intestine (66.7%), hyperplastic changes were slowly formed in the germinal area of the Malt structure (53.3%), the serous membrane was of different thickness. , it was found that the goblet cells located in the intestinal villi were of different sizes, there were many foci of focal necrosis in the mucocytes (66.7%), fibrinoid swelling foci were observed in the stroma of the muscle layer (46.7%). In lymphoid follicles of this organ, slow-developed proliferation (80.0%), anemic foci (86.7%) were detected in parafollicular capillaries.

8. Proliferation of fibroblasts developed in the stroma of the villi of the small intestine of laboratory animals (66.7%), dystrophic and necrotic foci in secretory cells (53.3%), necrotic-erosive changes in mucocytes on the surface of the villi (53.3%).

9. Histological preparations prepared from the small intestine of white rats that received the biologically active supplement "Lactopropolis-AWL" once a day until acute radiation were studied revealed full villi, interstitial swellings in the stroma (33.3%), uneven interstitial swellings in the serous membrane (46.7%). Foci of hydropic dystrophy were detected in the mucocytes on the surface of the villi (40.0%), increased proliferation of fibroblasts was observed in the stroma of the villi (40.0%).

10. When studying the histological picture of the small intestine of white non-breed rats that received an appropriate dose of the biologically active supplement "Lactopropolis-AWL" once a day until the acute irradiation, changes in the morphological characteristics of the small intestine were observed in most of them, but the intensity of these changes was related to the biologically active "Lactopropolis-AWL" was lower compared to non-supplemented white rats.

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