AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 5,September ,2025

RECYCLING AND ADAPTATION OF ENZYME SECRETION OF HYDROLYTIC ENZYMES OF THE PANCREAS AND ENZYME HOMEOSTASIS DURING γ-IRRADIATION

I.B. Klicheva

Andizhan State Medical Institute, the Republic of Uzbekistan

Key words: homeostasis, hydrolytic enzyme, reproduction, incretion

The influence of different doses of γ-rays on the secretion of pancreas's ferments and fermental homeostasis has been studied in white laboratory non-pedigree male rats (weight 180-200g). The obtained findings showed that γ-radiation depending on its dosage decreases synthesis of enzymes (amilaza, lypaza and proteaza) in the pancreas and their (amilaza and lypaza) incretion to the blood.

РЕЦИРКУЛЯЦИЯ И АДАПТАЦИЯ ФЕРМЕНТОВ СЕКРЕЦИИ ГИДРОЛИТИЧЕСКИХ ФЕРМЕНТОВ ПОДЖЕЛУДОЧНОЙ ЖЕЛЕЗЫ И ФЕРМЕНТНЫЙ ГОМЕОСТАЗ ПРИ γ- ОБЛУЧЕНИИ

И.Б. Кличева

Андижанский государственный медицинский институт, Республики Узбекистан

Ключевые слова:гомеостаз,гидролитический фермент,рекреция,инкреция

На белых лабораторных беспородных крысах самцах, весом 180-200г. изучили влияние разных доз γ- лучей на секрецию ферментов поджелудочной железы и ферментный гомеостаз. Полученные результаты показали, что γ-излучение в зависимости от дозы снижает синтез ферментов (амилазы, липазы, и протеазы) в поджелудочной железе и инкрецию их (амилазы и липазы) в кровь.

Every person is exposed to natural radiation. Human activities involving the use of radiation and radioactive substances result in additional irradiation along with natural [1,2,3]. Medical use of radiation makes the largest and growing contribution to anthropogenic irradiation [4,5]. It is known that the digestive system is one of the most sensitive to the effects of radiation [6], but the pancreas is considered a relatively radioresistant organ, since even at doses that cause acute radiation sickness (700-1000 R), there are no significant morphological abnormalities in it [7]. The glands of the digestive tract secrete secretions, recretions, and excretions into their ducts, organ cavities, and into the lymph and bloodstream. A significant portion of the secreted hydrolytic enzymes is absorbed from the small intestine into the lymph flow and circulating bloodstream. Free and adsorbed proteins, formed elements, endothelium of blood capillaries, and inhibitors are found in blood plasma. Enzymes are secreted by glandular cells into the chyme, take repeated part in the hydrolysis of food nutrients and secretions, i.e. recirculate in the macroorganism. Hydrolases have the properties of signal molecules, have regulatory and modulating effects on the processes of secretion and respiration of enzymes, on the organization of the adapted to the nutrient composition of the food and chyme, motility. In the urgent enzymatic adaptation of the secretion of the digestive glands, the principle of morphofunctional

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5,September ,2025

organization of the activity of the digestive secretory-transport modules plays a significant role. Each of them has specialized sensory, conductive afferent and efferent elements, and in the gland itself - specialized microregions and a system of secretion ducts with a microreservoir-valve apparatus. The pancreas maintains enzymatic homeostasis by incretion into the blood and respiration from it of enzymes [8]. This necessitates a comparative study of the effect of different doses of γ-rays on the secretion of pancreatic enzymes and enzyme homeostasis. Materials and methods of the study. The experiments were performed on white laboratory outbred male rats weighing 180-200g. Total irradiation of rats with γ-quanta of 60Co was carried out using the Luch setup, the size of the irradiated field was 20x20cm, the skin focal distance was 75 cm. The dose rate varied within 0.86-0.85 Gy/min. The absorbed doses were 1, 2, 4, 6 Gray. On days 1, 3, 7, 10, 20, 30, 45 and 60 after irradiation, the enzyme activity in the pancreatic tissue homogenate and in the blood serum was studied. The parameters of intact rats not exposed to any effects served as a control.

Discussion of the results. The obtained results showed that in the rat pancreas homogenate the most pronounced amylolytic activity is 1460±56.0 units/g. This enzyme, synthesized by acinocytes, hydrolyzes α-1-4-glucosidic bonds of polysaccharides. Hydrolysis of polysaccharides, initiated in the stomach by salivary carbohydrases, is vigorously continued by pancreatic α-amylase and is completed by several intestinal disaccharides. In second place in activity in the rat pancreas homogenate are total proteases 230.0±6.1 units/g. Proteolytic enzymes are synthesized and secreted by acinocytes in an inactive, zymogenic form in the form of trypsinogens, chymotrypsinogens, procarboxypeptidases, proelastases. In the rat pancreas homogenate, the activity of lipase is much lower than that of the previous enzymes. Its value is 70.1±3.1 units/g. This enzyme is synthesized and secreted by acinocytes in an active state. Pancreatic lipase is the main and essentially the only lipolytic enzyme that breaks down dietary triglycerides, which make up 90% of dietary fats consumed by humans.

The results we obtained for blood enzymes in rats: amylase activity is quite high, it is equal to 560.0±11.0 units/ml. In the blood, lipolytic activity is much lower (16.0±0.2 units/ml) than its amylolytic activity.

In the blood, the pattern we noted for the expression of amylase and lipase enzyme activity in the pancreatic homogenate is repeated.

After γ-irradiation at doses of 1, 2, 4 Gray, amylolytic activity in pancreatic tissue decreased on the 3rd day (Table 1). On the 7th and 10th days, the decrease in the activity of this enzyme reached its maximum values, i.e. this indicator was 20-40% lower than the control values.

On the 60th day after γ-irradiation at a dose of 1 and 2 Gray, the amylolytic activity of the pancreatic tissue reached its initial values.

With an increase in the dose of γ-irradiation, the changes in the amylase activity in the gland tissue were more pronounced. With γ-irradiation at a dose of 4 Gray, the amylolytic activity in the gland tissue decreased and remained at this level until the 60th day after irradiation. When the animals were irradiated with a dose of 6 Gray, the amylase activity in the pancreatic tissue sharply decreased after 24 hours (28% lower than the control). On the 3rd day after γ-irradiation,

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5,September ,2025

its activity slightly recovered (it became 13% lower than the control), but in the following days it became lower and lower, and on the 30th day it became 70% lower than the control.

The results we obtained confirm the data of V.S. Tkachishin [9] on dose-dependent changes in enzyme activity during irradiation.

A decrease in the secretion of pancreatic enzymes may be the result of a weakening of the stimulating effects at the level of their generation, as well as the conduction of signals in the neuronal chain of the meta-sympathetic ganglia of the gland [10,11,12], as well as a result of the suppression of neurohumoral regulation processes, expressed in a violation of the balance of adrenergic and cholinergic mediation in the gastrointestinal tract, the predominance of destructive processes and microcirculation disorders, and a violation of the balance of hormones and mediators [13]. A decrease in the activity of pancreatic enzymes may also be the result of a violation of enzymatic protein synthesis. Pancreatic enzymes are transported into the blood by several proven mechanisms: from the lumen of the small intestine, from destroyed acinocytes, the lumen of the duct system of the gland and by incretion of enzymes by pancreatic acinocytes [10]. The quantitative ratio of these transport routes can change depending on the functional state of the gland and small intestine, the permeability of their histohematic barriers, the level of blood supply to the gland and, apparently, other reasons.

In experimental rats after γ-irradiation, dose-dependent decrease in blood amylase activity was observed (Table 2).

With an increase in the radiation dose, a more pronounced decrease in amylolytic activity in the blood is observed, at a dose of 1 Gray by 2.5-8%, 2 Gray by 3-16%, 4 Gray by 5-12%, 6 Gray by 50-84% below the control. With γ-irradiation, dose-dependent changes in lipase activity in the tissue of the pancreas and blood were obtained. At doses of 1 and 2 Gray, the lipolytic activity in the homogenate of the gland tissue and blood remained at the level of the initial values (Tables 3, 4). This means that these doses do not affect the secretion of lipase by the pancreas and its incretion into the blood.

With an increase in the dose to 4 Gray, the lipase activity in the gland tissue on the next day of γ-irradiation decreased approximately twofold, on the tenth day after irradiation its activity became 3 times lower than the initial values. On the 60th day of observation, the lipolytic activity in the pancreatic tissue also remained much lower than the control values.

At a dose of 6 Gray, the lipolytic activity of the tissue on the next day after irradiation decreased approximately 3 times, on days 20-30 this indicator became 4 times lower than the initial values.

Similar changes were observed in the lipolytic activity of the blood with γ-irradiation at a dose of 4 and 6 Gray.

A day after γ-irradiation at a dose of 4 Gray, the lipolytic activity of the blood decreased by 30%. Starting from the 7th to the 30th day after irradiation, the lipase activity in the blood gradually recovered, but did not reach the control values, it remained 10% below its level. On the 45th day after irradiation, a more pronounced decrease was observed, i.e. lipolytic activity became 25-

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5,September ,2025

27% lower than the initial values, on the 60th day it did not recover to the initial values, remaining 15% below its level.

When experimental animals were given γ-irradiation at a dose of 6 Gray, a wave-like change in the lipolytic activity of the blood was observed. A day after irradiation, lipase activity in the blood decreased by 6%, after 3 days it became 25%, on the 7th day 48% - and on the 30th day 12% below the control.

Changes in the total proteolytic activity of the pancreatic tissue also depended on the dose of γ-irradiation.

With γ-irradiation at a dose of 1 Gray on the tenth day of the experiment, the total proteolytic activity of the glandular tissue decreased by 18%, on the twentieth day it returned to the initial values. On days 30 and 45 after irradiation, its activity in the pancreatic tissue significantly decreased, and on day 60 of the experiment, the activity of total protease returned to the control level.

At a dose of 2 Gray, a different picture of changes in protease activity in the pancreatic tissue was observed. At first, it decreased by 37% and then gradually, on day 45 of the experiment, it returned to the original values.

With γ-irradiation at 4 Gray, on the next day of the experiment, proteolytic activity in the gland tissue decreased by 13%, from day 20 to day 60 of the experiment, its activity became approximately 4 times lower than the initial level.

When animals were irradiated at a dose of 6 Gray, on the next day, protease activity in the gland tissue decreased by 30%, and in the following days of the experiment, its activity decreased more and more, on day 30 of the experiment it became 2 times lower than the control.

Conclusions:

1. The rat pancreas contains enzymes that hydrolyze almost all macronutrients - proteins, lipids and carbohydrates. In the pancreatic tissue, their ratio is not the same. Most enzymes have amylolytic activity, then proteolytic and the least lipolytic activity. The content of amylase and lipase enzymes in the blood is much less than in the pancreatic tissue.

2. Gamma radiation, depending on the dose, reduces the synthesis of enzymes (amylase, lipase, and protease) in the pancreas and their incretion (amylase and lipase) into the blood.

L I T E R A T U R E

1. Karpov A.B., Takhauov R.M., Urut V.V. The role of ionizing radiation in the development of homeostatic imbalance. // Bulletin of Siberian Medicine: scientific and practical journal. - 2005, - №2. - P.82-87.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 5,September ,2025

2. Petrova G.V. Incidence of malignant neoplasms in the territories affected by the Chernobyl accident (1981-2006). // Medical radiology and radiation safety. - M., 2009. - №1. - P.16-18.

3. Tokarskaya Z.B., Khokhryakov V.F. On the risk factors for malignant tumors among workers of the Mayak Production Association // Medical radiology and radiation safety. - M., 2010. - №2. - P.-32.

4. Bushmakov A.Yu., Baranov A.E., Nadezhda I.M. Three cases of acute radiation damage to humans from external gamma radiation. // Bulletin of Siberian Medicine: scientific and practical journal. - 2005, - v. 4, №2. - P.133-140.

5. UNSCEAR reports on the effects of atomic radiation to the General Assembly. // Medical radiology and radiation safety. - Moscow, 2010.- №1.- P.28-47.

6. Babadzhanova Sh.A., Shamsutdinova M.I., Musaeva I.B. Pathology of the digestive system in individuals exposed to low-dose irradiation. / Modern approaches to diagnostics and treatment of diseases of the hematopoietic system. Actual problems of trans physiology: collection of scientific papers of a scientific and practical conference with international participation. - Tashkent, 2006. - P. 68.

7. Surinov B.P., Sheyanov G.G. Structural and functional state of the pancreas and some of its hydrolases during irradiation. // Radiobiology.-M., 1979.-№1. -P.60-65.

8. Korotko G.F. Secretion of the pancreas. - Krasnodar: Kuban State Medical University, 2017. - 312s.

9. Tkachishin V.S. Retrospective assessment of the body's radiation dose by the activity of alanine aminotransferase and aspartate aminotransferase. // Medical Radiology and Radiocine Safety.-M., 1997.- №6. -P.43.

10. Korotko G.F. Endocretion of enzymes in modulation of digestive tract activity // Rus. journal gastroenterol. hepatol. coloproctology. -2007.-№5.-P.97-104.

11. Telbisz A., Kovics AL, Somosy Z. Influence of X-ray on the autophagic-lysosomal system in rat pancreatic acini // Micron. -2002.- v.33,№2.-P.143-151.

12. Yamaguchi K., Nakamura K., Kimura M., Yakakota K., Noshiro H., Chijiiwa K., Tanaka M. Intra operative radiation enkances decline of pancreatic exocrine function after pancreatic head resection. // Radiat Res. -2000 . –v.45,№6.-P. 1084-1090.

13. Ershov A.V., Sherbak N.P. Changes in the innervation of the stomach of rats under chronic exposure to ionizing radiation in small doses. // Scientific and theoretical medical journal. Morphology. - St. Petersburg, 2000. -v. 117, №3. -P.