INTERNATIONAL MULTI DISCIPLINARY JOURNAL FOR RESEARCH & DEVELOPMENT
eISSN 2394-6334 Impact factor: 7,854 Volume 12, issue 12 (2025)

ADAPTATION OF PANCREATIC ENZYMES AFTER Γ-IRRADIATION

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Abstract: The problem of radiation injuries has become particularly relevant worldwide due to the widespread use of nuclear energy and radioactive substances in industry, agriculture, medicine, and research. This study aimed to investigate the secretion of pancreatic enzymes under γ-irradiation in adult male rats. Experiments were conducted on 60 rats exposed to Co^{60} γ-radiation at doses of 1, 2, 4, and 6 Gy. Pancreatic enzyme activities (amylase, lipase, and total proteases) were measured at different time points (1, 3, 10, 20, 30, 60 days). The results showed dose-dependent decreases in enzyme activity, with partial recovery at lower doses (1–2 Gy) and persistent suppression at higher doses (4–6 Gy). The reduction in enzyme activity may be associated with disrupted neurohumoral regulation, impaired protein synthesis, microcirculatory disorders, and hormonal imbalances. Two periods of functional changes were identified: an initial stress-response phase and a subsequent phase of impaired enzyme synthesis and metabolic regulation.

Keywords:γ-irradiation, pancreatic enzymes, amylase, lipase, proteolytic activity, rats, radiation biology

The problem of radiation injuries has become particularly relevant worldwide over the past decade. This is associated with the widespread use of nuclear energy and radioactive substances in various sectors of the national economy—industry, agriculture, medicine, and research institutions. As a result, an increasing number of people are exposed to the harmful effects of ionizing radiation, which often lead to severe and irreversible consequences. Considering this, the present study aimed to investigate the secretion of pancreatic enzymes under γ-irradiation.

Experiments were conducted on 60 adult outbred male rats weighing 150–200 g. Irradiation was performed using the "Luch" device, delivering Co^{60} γ-radiation. The irradiated area was 20×20 cm, with a focus distance of 75 cm. The irradiation dose was 0.85–0.86 Gy/min, with absorbed doses of 1, 2, 4, and 6 Gy. After irradiation, the rats were euthanized under ether anesthesia at 1, 3, 10, 20, 30, and 60 days. Amylase, lipase, and total proteolytic activity were determined in the pancreatic tissue homogenates. Intact rats served as controls, with enzyme activities in the pancreatic homogenates as follows: amylase 1460±56.0 U/g, total proteases 230.0±6.1 U/g, lipase activity 70.1±3.1 U/g.

The results showed that after γ-irradiation at doses of 1, 2, and 4 Gy, amylolytic activity in the pancreatic tissue decreased by day 3. On days 7 and 10, the reduction of this enzyme activity reached its maximum, i.e., the level was 20–40% lower than in the control group. By day 60 after γ-irradiation at doses of 1 and 2 Gy, the amylolytic activity of pancreatic tissue returned to baseline levels.

With increasing γ-irradiation doses, changes in pancreatic amylase activity were more pronounced. At a dose of 4 Gy, amylolytic activity decreased and remained at this level until day 60 after irradiation. When animals were irradiated with a dose of 6 Gy, amylase activity in the pancreatic tissue sharply decreased within 24 hours. By day 3 after γ-irradiation, its activity

slightly recovered but progressively declined in the following days, reaching 70% below the control level by day 30.

At doses of 1 and 2 Gy, lipolytic activity in pancreatic tissue homogenates and blood remained at baseline levels, indicating that these doses did not affect pancreatic lipase secretion or its level in the blood. At a dose of 4 Gy, lipase activity in pancreatic tissue decreased approximately twofold on the day after irradiation and was three times lower than baseline by day 10. Even by day 60, lipolytic activity remained significantly below control values. At a dose of 6 Gy, lipase activity in the tissue decreased threefold on the day after irradiation and became four times lower than baseline by days 20–30.

Changes in total proteolytic activity of pancreatic tissue also depended on the γ-irradiation dose. At 1 Gy, total proteolytic activity decreased by 18% on day 10 but returned to baseline by day 20. On days 30 and 45, tissue activity decreased again, returning to control levels by day 60. At 2 Gy, protease activity initially decreased by 37%, then gradually returned to baseline by day 45. At 4 Gy, proteolytic activity decreased by 13% on the day after irradiation and remained approximately four times below baseline from days 20 to 60. At 6 Gy, protease activity decreased by 30% on the first day and continued to decline in the following days, reaching half of the control level by day 30.

The reduction in pancreatic enzyme secretion may result from weakened stimulatory influences at the level of their generation, impaired signal transmission along the neurons of the pancreatic metasympathetic ganglia, or inhibition of neurohumoral regulation, manifested as an imbalance between adrenergic and cholinergic mediation in the gastrointestinal tract, predominance of destructive processes, microcirculatory disorders, and hormonal and mediator imbalance. Reduced pancreatic enzyme activity may also result from impaired enzymatic protein synthesis.

Thus, in the development of functional changes in animals under experimental γ-irradiation, two periods can be distinguished: an initial period characterized by stress-response changes and a subsequent period, during which disruptions in enzyme protein synthesis occur in the pancreas, leading to impaired control and coordination of various metabolic pathways.

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