

# **GAMMA RADIATION INDUCED ALTERATIONS IN THE ULTRASTRUCTURE OF PANCREATIC ISLET, METABOLISM AND ENZYMES IN WISTAR RAT**

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## **ABSTRACT**

Effects of gamma irradiation (600 rads) on the ultrastructure of pancreatic islet, metabolism and some enzymes in wister rat, are reported. Electron microscopic observations of endocrine pancreas revealed prominent changes in beta cells while alpha and delta cells were not much affected. Irradiation also inflicted hyperglycemia, increase in liver and muscle glycogen and decrease in insulin level. It has also increased the activity of enzymes but failed to produce significant changes in protein, lipid and mineral metabolism.

## **INTRODUCTION**

Though large number of information is available on long term effects of radiation, studies on immediate effects are comparatively a few. This investigation deals with the immediate effects (observed after 24 hours) of gamma irradiation (600 rads) on the ultrastructure of pancreatic islet, carbohydrate, protein, lipid and mineral metabolism and some enzymes.

## **MATERIAL AND METHODS**

Twenty acclimatized male rats were exposed to 600 rads of gamma rays (Co-60) with a dose rate of 39 rads/min. Equal number of animals served as a control group. The animals were sacrificed after 24 hours and blood samples were collected and were subject to biochemical analyses. For electron microscopic observations the pancreas was fixed in 3% glutaraldehyde and blocks were prepared in araldite. The ultrathin sections were stained with uranyl acetate and lead nitrate and observed under JEM-T-8 electron microscope.

## **RESULTS AND DISCUSSION**

Ultrastructural changes included degenerative effects and vacuolization of the cytoplasm in alpha and beta cells (Plate I). The decrease in hormone granules was observed in beta cells while no noticeable changes were seen in alpha and delta cells. The presence of less number of hormone granules in the beta cells suggests reduction in insulin secretion which agrees well with observations in golden hamster (Tsubouchi and Sasumu, 1981).

Gamma irradiation inflicted changes in the carbohydrate metabolism and some enzymes but failed to produce significant changes in protein, lipid and mineral metabolism (Table I).

The changes in carbohydrate metabolism include pronounced hyperglycemia with a marked decline in serum insulin level. Liver and muscle glycogen showed significant increase after irradiation which can be attributed to the fact that the irradiation stimulates secretion of corticosteroids which enhances deposition of glycogen in the liver and muscle (Malatova et al., 1977).

The irradiation is known to cause an increase in gluconeogenesis from the amino acids (Kandysh and Moroz, 1979), and decrease in glucose utilisation by cells (Ahlersova, 1980). The hyperglycemia observed in the present study may be the result of release of amino acids from the destroyed tissues and less uptake of glucose by the cells.

Except for serum glutamate pyruvate transaminase, all other enzymes studied, showed significant increase in the concentrations after irradiation. This might be due to increased permeability consequent upon the disturbed metabolism. The enzymes diffuse abnormally from the cell to the plasma because of increased permeability which can be considered as an early non-specific reaction of every cell when its metabolism is disturbed.

## CONCLUSIONS

Gamma irradiation reduced the synthesis of insulin as confirmed by the decrease in the hormone granules of the beta cells and decline in serum insulin level. The irradiation might have stimulated release of corticosteroids leading to hyperglycemia and deposition of glycogen in the liver and muscle. Proteins, lipids and minerals remained almost unchanged. Prominent increase in some enzymes concentration can be attributed to the diffusion of enzymes from the cell into the plasma due to change in the permeability.

## REFERENCES

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## ACKNOWLEDGEMENTS

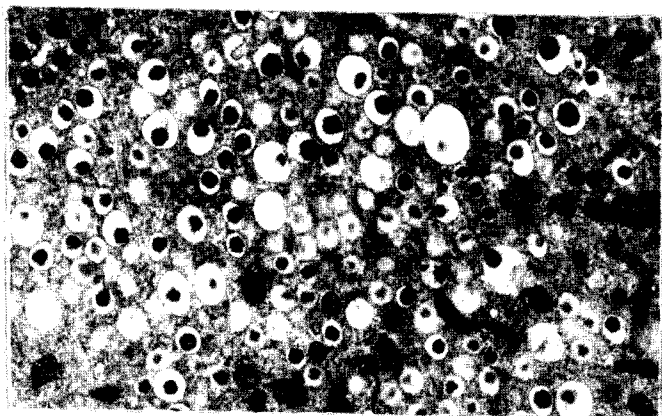
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Table I - Effect of gamma rays (600 rads) on various parameters.

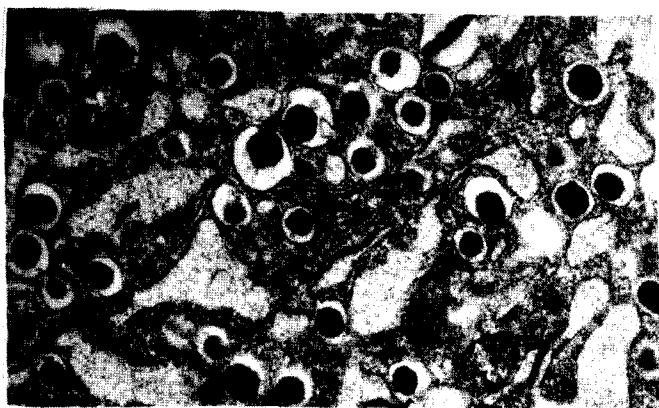
Sr.No.	Parameter	Control	Irradiated (600 rads)
1.	Blood glucose (mg/100 ml)	84.20 $\pm$ 1.13	194.00 $\pm$ 3.56 (P < 0.001)
2.	Liver glycogen (g/100 g)	1.92 $\pm$ 0.17	6.97 $\pm$ 0.44 (P < 0.001)
3.	Muscle glycogen (g/100 g)	0.99 $\pm$ 0.06	4.90 $\pm$ 0.31 (P < 0.001)
4.	Serum insulin (IU/ml.)	115.00	50.00 $\pm$ 2.83 (P < 0.05)
5.	Serum amylase (Somogyi Units)	605.00 $\pm$ 4.40	682.00 $\pm$ 6.77 (NS)
6.	Serum lactic dehydrogenase (IU/lit.)	268.00 $\pm$ 12.50	997.00 $\pm$ 11.68 (P < 0.001)
7.	Serum glutamate oxalate transminase (IU/lit.)	70.50 $\pm$ 4.98	123.00 $\pm$ 3.56 (P < 0.05)
8.	Serum glutamate pyruvate transaminase (IU/lit.)	40.00 $\pm$ 2.77	24.00 $\pm$ 2.43 (P < 0.05)
9.	Serum acid phos- phatase (IU/lit.)	22.03 $\pm$ 1.55	24.00 $\pm$ 1.46 (NS)
10.	Serum alkaline phosphatase (IU/lit.)	8.30 $\pm$ 0.70	108.00 $\pm$ 2.92 (P < 0.001)

Note: 1) Values are given as mean  $\pm$  standard error for 20 animals.  
2) P indicates the level of significance  
3) NS means non-significant.

Plate I



Electronmicrophotograph of beta granules  
before irradiation (X10000)



Electronmicrophotograph of beta granules  
after irradiation at 600 rads (X15000)