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Study on the effect of food irradiation on some blood serum enzymes in rats

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With 2 tables

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The value of ionizing radiation for food preservation arises from its ability to destroy the microorganisms and insects that cause spoilage and deterioration of food. By the use of the irradiation processes, the storage life of some food stuffs may be extended considerably. Thus irradiation offers a valuable addition to the total amounts of food available in the world by helping the reduction of the serious losses that occur at all stages between production and consumption of the food stuffs.

It has been shown that food irradiation leads to several adverse effects in animals fed such irradiated diets. *Ehrenberg* (6) showed that injection of irradiated glucose leads to decreased total leucocytic counts in rats. *Ehrenberg* and *von Ehrenstein* (7) have reported the same findings in rats receiving irradiated diets. *Mameesh* et al. (10) have reported that feeding irradiated beef to rats leads to a state of vitamin K deficiency and hemorrhage.

Thus it has been recommended by the Expert Committee of FAO/IAEA/WHO (16) that some forms of biological screening tests must be done to insure the absence of substances that can produce adverse effects in man and higher animals to decide the safety of an irradiated food. Among these biological tests recommended are the study of tissue and blood serum enzymes which may be useful indicators for biological effects.

In the present work, the effect of feeding an irradiated food on the activities of some blood serum enzymes in rats have been studied. These enzymes are serum glutamic-pyruvic transaminase (SGPT), glutamic-oxalacetic transaminase (SGOT), and serum lactic dehydrogenase (LDH). These enzymes were selected because of their importance as diagnostic tests for the liver functions.

Material and methods

Diet: The diet which was irradiated and given for the experimental animals was a natural diet having the following composition:

Ingredients	g/100 g
Casein	8.50
Skimmed milk	9.40
Potato starch	50.00
Wheat flour	16.50
Sucrose	5.00
Sun flower oil	6.00
Choline chloride	0.10
Salt mixture (15)	3.50
Vitamin mixture (11)	1.00

The diets were irradiated by exposure to ionizing radiation source which was Cobalt-60, till the required doses 2.5 and 4.5 M-rads have been absorbed. The diets were stored in polyethylene bags and no other technological processes were accomplished. The vitamin mixtures were added after and without irradiation.

Animals: The work was carried out on rats of the Sprague-Dawley strain weighing 150-170 g, animals were kept in wire-bottomed cages. The animals were assembled into three groups of hundred animals each comprising fifty animals from each sex. The three groups represent a control group maintained on a non-irradiated diet; the second and the third were fed the irradiated diets of 2.5 and 4.5 M-rads, respectively. The temperature of the animal house was adjusted at $27 \pm 2^\circ\text{C}$ and relative humidity of 50-55%. Food and water were given ad libitum for four months. At the end of the feeding experiment, animals were killed by decapitation, blood samples were taken and sera were separated for enzyme assays.

Enzyme assays: Blood serum transaminases SGPT and SGOT were assayed using the colorimetric method described by Reitman and Frankel (12). Serum LDH activity was determined following the spectrophotometric method described by Amador, Dorfman, and Wecker (1). LDH unit of activity was expressed as $\mu\text{Mol NAHD/min/liter}$.

Results and discussion

The results obtained were statistically analyzed using the *Student t* test and presented in the accompanying tables.

From the tables, it is clear that blood serum transaminases SGPT and SGOT activities showed very slight increase in males than females in the control group, yet these changes were statistically non-significant. In this

Table 1. Response of blood serum transaminases and lactic dehydrogenase activities to irradiated food in male rats.

Group	SGPT		SGOT		LDH	
	Mean	SE	Mean	SE	Mean	SE
Control	4.75	± 0.15	10.50	± 0.76	717	± 60
Group A	4.30	± 0.57	8.00	± 1.08	605	± 26
p	non sig.		non sig.		non sig.	
Group B	4.13	± 0.30	9.46	± 0.60	730	± 84
p	non sig.		non sig.		non sig.	

Table 2. Response of blood serum transaminases and lactic dehydrogenase activities to irradiated food in female rats.

Group	SGPT		SGOT		LDH	
	Mean	SE	Mean	SE	Mean	SE
Control	4.23	± 0.31	11.9	± 0.78	637	± 91
Group A	4.69	± 0.32	9.10	± 0.81	545	± 37
p	non sig.		0.02		non sig.	
Group B	3.76	± 0.26	9.16	± 0.76	500	± 39
p	non sig.		0.02		non sig.	

N.B. Group A: Animals fed the irradiated diet of 2.5 M-rads,

Group B: Animals fed the irradiated diet of 4.5 M-rads.

respect, controversial results have been reported by several authors; while Shaw et al. (13) reported that sex differences are present being higher in females, Siekert and Fleisher (14) showed higher values in females for SGOT. Amador et al. (2) reported that there are no sex differences with respect to SGPT while Henry et al. (8) reported higher activities in the normal males than females.

Serum LDH activities showed slight but statistically non-significant increase in males compared with females in the control group. This finding agreed well with that reported by Cohen et al. (5).

Feeding an irradiated diet showed non-statistically significant differences in SGPT activities neither in relation to the dose of irradiation nor to the sex differences when compared with the control groups.

For SGOT, there were no significant changes due to irradiation doses in male rats, while there was a statistically significant decrease in enzyme activities in the female groups for both receiving 2.5 and 4.5 M-rad irradiation doses ($p < 0.02$). Knox et al. (9) have reported that such changes in enzyme activities may be considered to present either changes in the level of enzyme protein or the coenzymes. In the present work the decreased activities of SGOT cannot be accepted as coenzyme deficiency since pyridoxine was given in amounts adequate for both groups and without irradiation. Differences in enzyme nature have been reported in several enzymes, especially transaminases (4). Cohen et al. (3) reported that low transaminase activities reflected the relation between the rate of transamination and protein synthesis by the removal of glutamic acid. The present work suggested some differences in the nature of serum transaminases due to sex differences although there are no detectable differences in their activities in the control groups.

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Summary

The effect of feeding an irradiated diet on the activities of some blood serum enzymes in rats have been studied. This study revealed some significant changes

of SGOT due to sex differences. The results obtained failed to show any significant changes in the enzyme activities of SGPT and serum LDH neither in relation to sex nor to the irradiation doses studied.

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