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**EFFECT OF GAMMA RADIATION ON CHOLINESTERASE ENZYME**  
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**ABSTRACT**

The paper studies the effect of gamma radiation on the activity of cholinesterase enzyme . The results showed that a change in the activity has occurred in the studied absorbed dose range from 10 KGy to 100 KGy . Proposals to interpret the variation of activity of irradiated cholinesterase enzyme in the studied doses are given . Moreover the effect of time after the radiolysis process on the activity of the enzyme is shown . The final conclusion suggests the replacement of gamma irradiation radiotherapy by alpha or beta radiation for local treatment of tumors to reduce the radiation noxious effects on intact cells and enzymes

**KEYWORDS**

Gamma radiation / Enzyme / Effect of radiation / Cholinesterase .

**INTRODUCTION**

Cholinesterase enzyme exists in blood and tissues . Its molecule has a complicated protein structure with two active centers on its surface . These active centers are anion center of negative charge and another ester center which is represented by hydroxyl group . The nervous pulses are transferred to muscles via decomposition of acetylcholine by cholinesterase enzyme which is specific for that decomposition [1,2]. The enzyme activity can be measured by the time required to decompose certain amount of acetylcholine at pH 7.4 at temperature 37 - 38 C [3-5] .

Inhibition of cholinesterase enzyme allows accumulation of acetylcholine . As a result , mixture of parasympathomimetic and sympathomimetic symptoms as well as voluntary muscle effects will be faced . All nonvascular smooth muscles of gut , bladder , bronchioles and constrictor of pupil are affected . Secretion of mucus and pepsin increases. Blood pressure is decreased and a bradycardia is produced. The accumulation of acetylcholine has also effects on motor nerve , central respiratory and central nervous systems. It causes also difficulty in swallowing and urinating. Therefore if gamma radiation inhibit the cholinesterase enzyme , the acetylcholine will be accumulated and the patient may feel all these symptoms [1,2]. It is important to take into consideration that the study of radiolysis of enzyme in free solutions differs from that in living cells , but studying the effects on vitro conditions gives imagination about the effects of radiation in vivo situation.

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Gamma rays, alpha and beta particles cause excitations and ionizations for the exposed material by different types of interactions and mechanisms. These excitations and ionizations produce and create radiolytic species which are the main reason for the radiolytic product. The average penetration distances in solids for alpha, beta and gamma irradiation are  $10^{-5}$ ,  $10^{-3}$  and  $10^{-1}$  meter respectively [6,7]. The effects of destruction of carcinogenic cells via excitations and ionizations processes may be attained higher by beta or alpha irradiation than gamma due to their higher linear energy transfer [8,9]. Therefore it is valuable to think for replacement of gamma exposure in radiotherapy by alpha or beta exposure to get the fetal effect on carcinogenic cells with lower noxious effects on intact cells and enzymes during radiation therapy.

### EXPERIMENTAL PROCEDURE

All utilized chemicals were of analytical grade. One gram of dried horse serum as a source of cholinesterase enzyme (which alikes reactions in human) was dissolved in 100 ml of bidistilled water. The buffer solution with indicator was prepared as one gram of sodium dihydrogen phosphate, nine grams of disodium hydrogen phosphate and one gram of bromothymol blue and dissolved such that the total volume was adjusted to 100 ml.

After irradiation the activity of the enzyme in the tested irradiated samples was determined as follows: 2.5 ml of each irradiated enzyme were taken in a clean test tube and 0.5 ml of buffer solution with indicator was added. The test tubes were heated in a water bath at 38 °C for 10 minutes. After heating, 0.5 ml of acetylcholine solution (which was prepared by dissolving one gram of acetylcholine in 100 ml of bidistilled water) was added. The time was measured till the color of the tube reached that of standard sample [3-5]. The irradiation process was performed as irradiating groups of ampoules filled with enzyme solution for different doses by Cs Gamma Cell Canada Limited whose dose rate was  $48.1932 \text{ Gy. h}^{-1}$ . The standard sample was prepared like tested irradiated sample except 0.5 ml of acetylcholine was replaced by 0.5 ml of 0.05 M acetic acid. The control sample was prepared by the same way except replacing the irradiated enzyme solution by the nonirradiated one.

Let  $T_c$  is the time required for the control sample to have the same color like the standard (or to measure the absorbance at  $\lambda = 402 \text{ nm}$ ) and  $T_i$  is the time required for the irradiated sample to have the same color of standard, then the percentage activity of the enzyme can be calculated as follows [3.4]:

$$\text{Percentage activity of enzyme} = \frac{T_c}{T_i} \times 100$$

The percentage activity of the enzyme was determined at 1, 10, 15, 20, and 24 hours after the radiolytic process.



Since gamma radiation has an effect on the activity of the studied important enzyme , similarly it is probable to affect on other enzymes. The irradiated persons suffer from symptoms of change of activity of cholinesterase and other enzymes. These symptoms may be utilized for characterization of radiation disease. Moreover , since the same destroying effect of carcinogenic cells may be attained by other less penetrating radiation like beta or alpha particles , it is interest to replace gamma exposure treatment by beta or alpha one to lessen the noxious radiation effects on other intact cells and enzymes during radiation therapy.

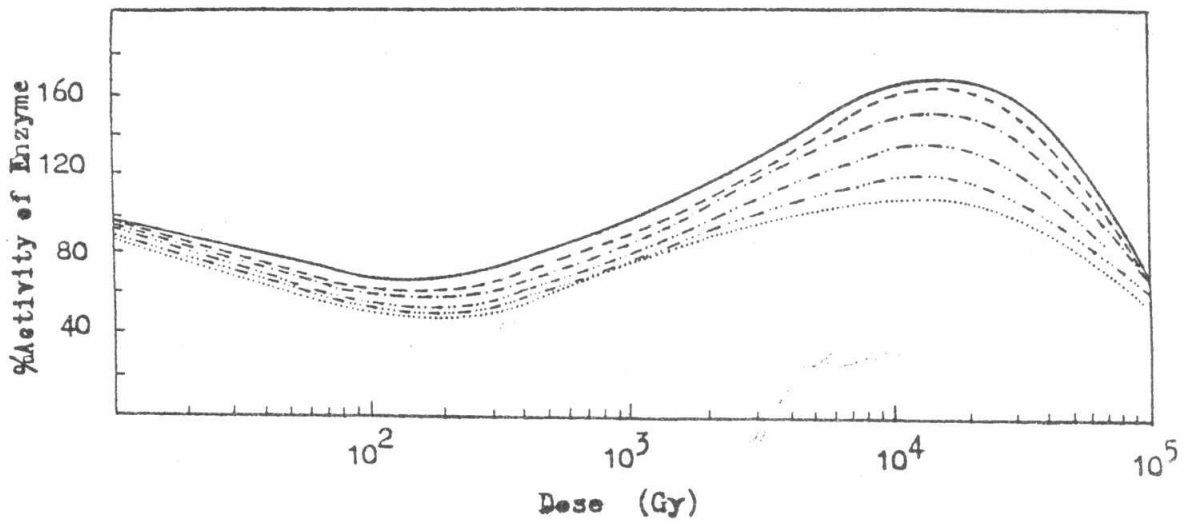


Figure (1) : Effect of gamma absorbed dose and time after the radiolysis on the activity of cholinesterase enzyme.

- : 1 h after radiolysis .
- - - - - : 5 h after radiolysis .
- . - . - : 10 h after radiolysis .
- - - - - : 15 h after radiolysis .
- . - . - : 20 h after radiolysis .
- ..... : 24 h after radiolysis .

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