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Effect of Gamma Irradiation on Some Types of Pathogenic Bacteria.

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ABSTRACT

This study deals with using gamma irradiation at low dose average, for determining of the dose response curve of gram-positive and gram-negative bacteria isolates were obtained from Bacteriology Laboratory of Biology Department, College of Science, University of Kufa. The results showed that, the variations of effect in all pathogenic bacteria were studied at range of dose from 0.11 Gy to 0.44 Gy, also the results proved the gram positive bacteria was more resistant to gamma radiation than gram negative bacteria, the inhibition zones for *Pseudomonas aeruginosa , Proteusmirabilis , E. coli , Staphylococcus aureus* which caused by gamma irradiation reached to (0.2 , 0.12 , 0.1 and 0.08mm) respectively compared with that control which was 0.3mm . Application of gamma radiation in treatment pathogenic bacteria revealed that 0.44 (Gy) reduced the viable count of gram negative and positive gram bacteria to become safe.

Keywords: Gamma radiation Pathogenic bacteria, Gram-positive bacteria and Gram-negative bacteria.

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INTRODUCTION

It is well know that the gamma rays have a short wavelength and high penetration power resulting from the nuclear disintegration of certain radioactive substances such as Cobalt 60 (Co-6o) and Cesium 137 (Cs-137) [1]. Ionizing radiation can be defined as radiation that has sufficient energy to remove electrons from atoms and molecules and to convert them to electrically-charged particles called ions. Additionally, reactions of ions and electrons, give rise to the formation of free radicals that are usually highly reactive and which eventually lead to chemical changes in the system that is produced by absorption of ionizing radiation which is known as radiation chemistry [2, 3]. Ionizing radiation can cause some damage in nucleic acids and ultimately kill microbes by direct and indirect hits. Direct hit occur when radiation directly disrupt nucleic acids, especially DNA. Gamma rays induced three types of damage in DNA namely, single strand breaks, double strand breaks and nucleotide damage which include base damage and damage in the sugar moiety [4]. Certain microorganism's exhibit resistance, extreme ionizing-radiation resistance has been observed in several members of the domains bacteria and archaic[7-9] . Resistance to ionizing radiation can be explained by sulfur-rich cell wall of the bacterial cells which make as scavengers for ionizing radiation or by DNA repair, mechanisms [8-10]. The present study aims to determine the effect of gamma radiation on pathogenic gram-positive bacteria isolates *Staphylococcus aureus*) and gram-negative (*E. coli*, *Pseudomonas aeruginosa*, *Proteus mirabilis*) .

MATERIAL AND METHODS

Bacterial isolates and Irradiation

Gram-positive and gram-negative bacteria isolates were obtained from Bacteriology Laboratory of Biology Department , College of Science , University of Kufa , Identification of bacterial isolates were based on biochemical tests which described by [11] .

Four types of pathogenic bacteria were divided into five groups with 3 bacteria (R1) First group as control group did not receive any radiation, (R2) was irradiated with 0.11Gy, (R3) was irradiated with 0.22Gy, (R4) was irradiated with 0.33Gy and (R5) was irradiated with 0.44Gy.. Irradiation was performed through the use of Cesium-137 source with 5 µCi from the International Atomic Energy Agency in a close system. The Cesium-137 radiation was taken in place was used so that three animals could be simultaneously irradiated.

Statistical evaluation

Statistical analysis for evaluation of the results was done by calculating arithmetic mean and standard deviation for all types of pathogenic bacteria under study. All these measurements had been done for all groups. Results were expressed as mean ± standard deviation for each group. The results were evaluated by Student's unpaired t-tests.

RESULTS AND DISCUSSION

The effect of gamma irradiation on inhibition for different types of pathogenic bacteria

The results revealed that gram +ve bacterial strains were more resistant to gamma radiation than gram –ve bacteria ,pathogenic bacterial strains the following as *Pseudomonas aeruginosa, Proteus mirabili, E. coli, Staphylococcus aureus*, the inhibition zone for *Pseudomonas Aeruginosa* which its reach to 0.2 cm while for *Staphylococcus aureus r*each to 0.08 cm compare with control in the use of the gamma radiation dose 0.44 Gy(table 1 and figure 1), the difference between gram +ve and gram –ve bacterial cells may be explained on the base of difference between them in cell wall structure, gram-positive bacteria have membrane which surrounded the cell and cell wall primarily made up of peptide glycan layer, this cell wall rich in sulfur compounds, which protect the cells from harmful gamma radiation and become resistant, sulfur compound found in cell wall of gram +ve bacterial cell make as scavenger for free radicals and protect the cells [12, 13, 14]. It is well known that, exposure of bacterial cells to ionizing radiation presents an additional stress to the cells which tends to disturb their organization, nucleic acids, especially DNA, are the primary target for cell damage from ionizing radiation, gamma radiation induced three types of damage in DNA, single strand breaks, double strand breaks and nucleotide damage which include base damage and damage in the sugar moiety, the

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base damage is a major component of damage induced by ionizing radiation [15]. The lethal effect of gamma radiation may be explained on the bases that gamma radiation induced DNA-damage, single or double strand breaks and disruptor of protein-DNA complex, so affecting gene expression [16-17] .

Table 1: The effect of gamma irradiation on different types of pathogenic bacteria

Process	Dose (Gy)	Inhibitionzone (mm)			
		Pseudomonas	***Proteus***	***E.coli***	***Staphylococcus***
Control	0	0.3±0.0019	0.3±0.002	0.3±0.00195	0.3±0.0021
Dose 1	0.11±0.01	0.27±0.002	0.24±0.0019	0.21±0.002	0.2±0.002
Dose 2	0.22±0.02	0.24±0.0019	0.20±0.0018	0.16±0.0018	0.14±0.0019
Dose 3	0.33±0.03	0.21±0.0018	0.16±0.0018	0.13±0.0017	0.11±0.0018
Dose 4	0.44±0.04	0.2±0.00185	0.12±0.0175	0.1±0.0016	0.08±0.00185

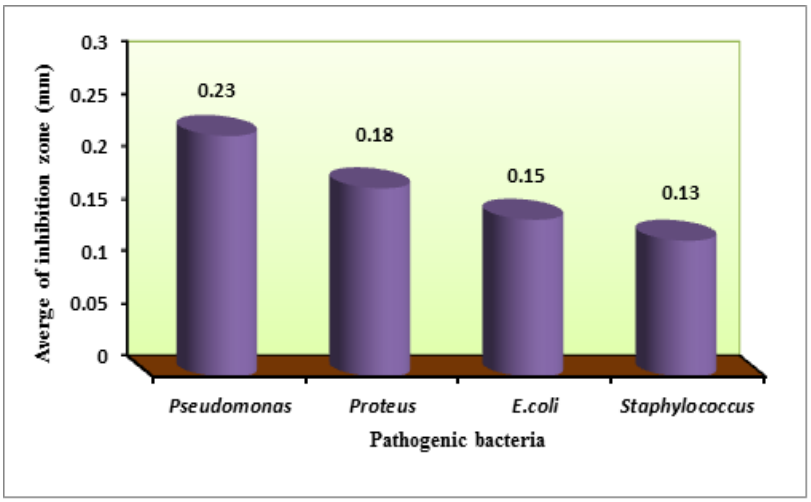

Figure 1: The average effective of inhibition zone for different types of pathogenic bacteria by gamma irradiation

The presence of a significant positive correlation (P<0.05) between gamma irradiation and inhibition of Pseudomonas (R^2 = 0.92), Figure (2). The presence of a significant positive correlation (P<0.05) between gamma irradiation and inhibition of *Proteus* (R^2 = 0.93), Figure (3).). The presence of a significant positive correlation (P<0.05) between gamma irradiation and inhibition of E.Coil (R^2 = 0.99), Figure (4). The presence of a significant positive correlation (P<0.05) between gamma irradiation and inhibition of *Staphylococcus* (R^2 = 0.97), Figure (5).

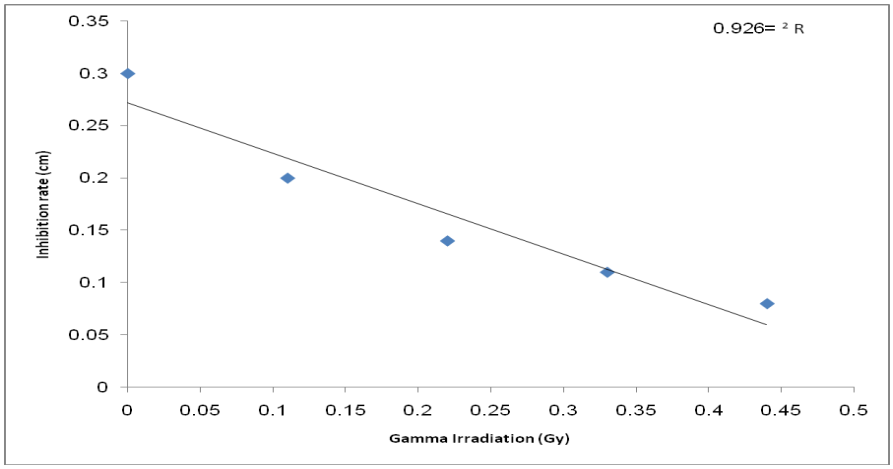

Figure 2: Correlation between gamma irradiation and inhibition of pathogenic bacteria type (*Pseudomonas*)

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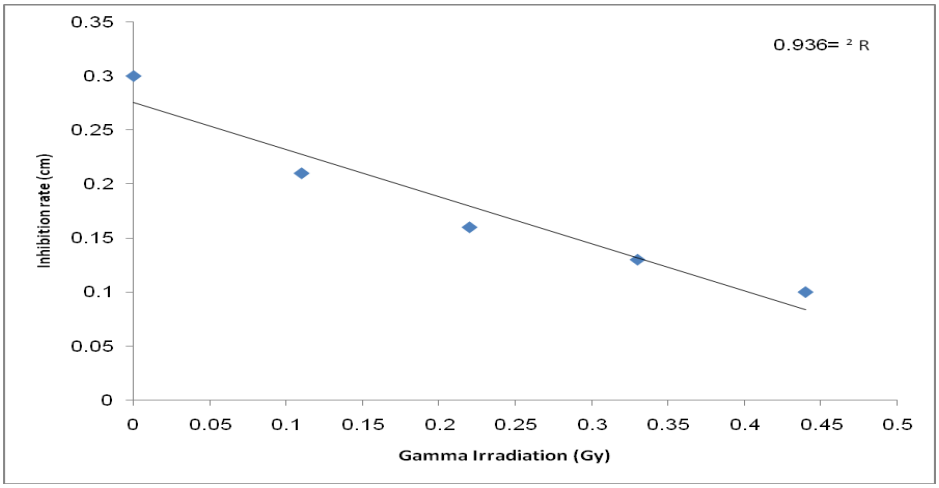

Figure 3: Correlation between gamma irradiation and inhibition of pathogenic bacteria type (*Proteus*)

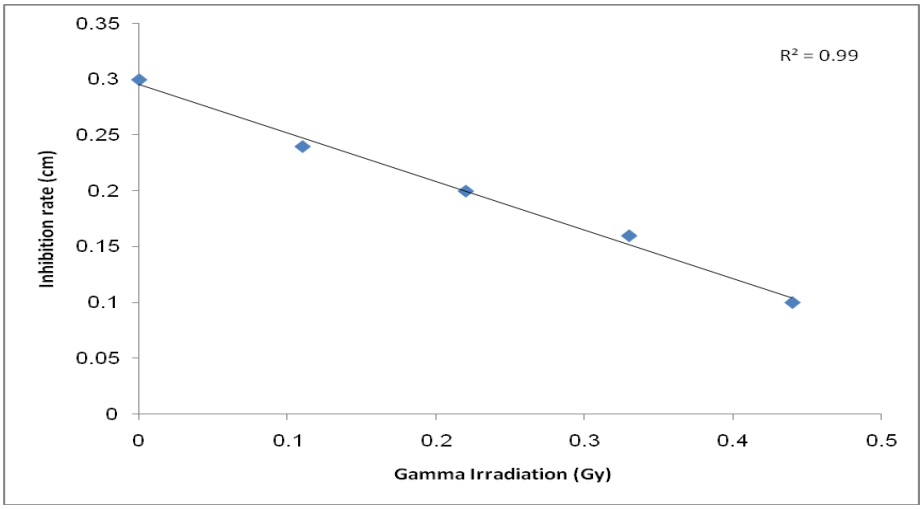

Figure 4: Correlation between gamma irradiation and inhibition of pathogenic bacteria type (E.Coil)

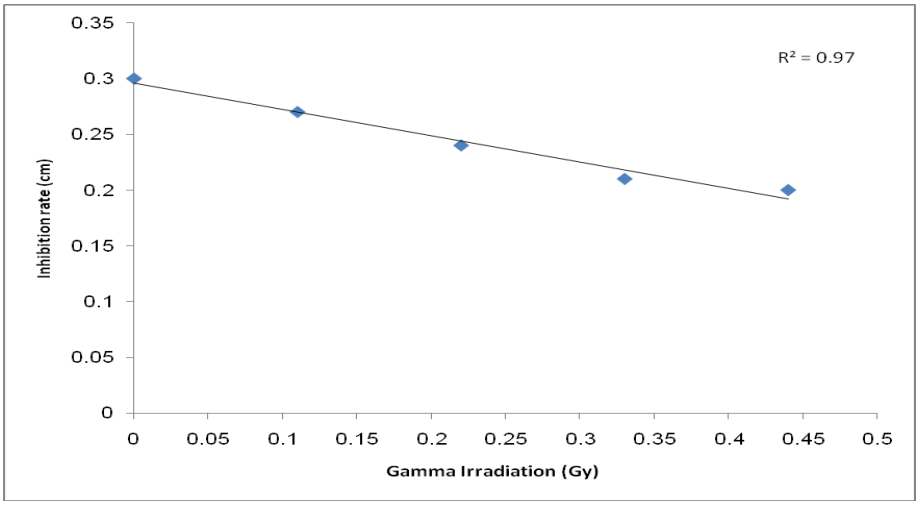

Figure 5: Correlation between gamma irradiation and inhibition of pathogenic bacteria type (*Staphylococcus*)

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CONCLUSION

In this study, gamma irradiation was found to be very effective on the negative bacteria, while positive bacteria was more resistant to gamma radiation. Also it may be conclude that the high value of gamma irradiation causes the viable count of gram negative and positive gram bacteria to become safe, therefore can be used gamma irradiation a new method for sterilizing.

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