

14.009 - Effects of low doses of gamma irradiation on the formation of mineralizing nodules - a Hermetic approach

Targino, B. , Figueiredo, A. , Somessari, E. S. R. , Affonso, R. ,
Centro de Biologia - IPEN
Gerencia de Produtos e Serviços - IPEN

Introdução:

In the fields of biology and medicine, hormesis is a biological response to the action of toxins and other stressors in low concentrations. In studies with osteoblasts, this definition can be true. Osteoblasts are specialized fibroblasts that secrete and deposit bone matrix. Irradiation therapies for some types of cancer cause massive bone loss; however, low-dose X-radiation can have the opposite effect on osteoblastic culture, increasing proliferation, differentiation, and formation of mineralizing nodules. As for the effects of Gamma Radiation at low doses, there is little information about bone regeneration.

Objetivos:

Evaluate the effects of irradiation with ^{60}Co γ -rays in low doses in the formation of mineralization nodules in the culture of osteoblasts.

Métodos:

MC3T3-E1 cells were bought by the Banco de Células do Rio de Janeiro, Brazil (MC3T3-E1 Subclone 14). The cells cultured in α -MEM medium consisting of 10% FBS and without β -glycerophosphate and L-ascorbic acid (GIBCO, Custom Product, Catalog No. A1049001) as described manufacturer.

Plating efficiency assays: cells were plated at a density of 100 cell/plate into 60 mm Petri dishes. After 14 days, the colonies were stained with violet crystal and counted.

Mineralization assays: cells were cultured in the same medium with 10 mM β -glycerophosphate and 50 mg/ml ascorbic acid and analyzed on days 7, 14, and 21.

Osteoblast culture irradiation assay: cells were plated at a density of 1×10^5 cells/plate on 60 mm dishes and the next day were irradiated by ^{60}Co source with 0 (as the control), 0.5, 1.0, 1.5, and 2.0 Gy using the GammaCell 220 - Irradiation Unit of Canadian-Atomic Energy Commission Ltd. (CTR-IPEN).

The analysis of the mineralization nodules of the cultures used the dye Alizarin red S (Sigma). All assays were in triplicates, and multiple comparisons were evaluated by One-way ANOVA followed by Bonferroni tests and GraphPad Prism software version 6.0. $P < 0.05$ (considered statistically significant).

Resultados:

The tests to evaluate the effects of gamma radiation at low doses used doses of 0, 0.5, 1.0, 1.5, and 2.0 Gy. The plating efficiency results obtained were 39% for non-irradiated cultures and between 15% and 11% for irradiated cultures. Regarding the evaluation of the formation of mineralization nodules per cm² significant difference in the 0.5 Gy group was observed compared with the control group (0 Gy), 64.7±1.8 and 53.0±0.9, respectively. The 1.0, 1.5, and 2.0 Gy dose groups had a decrease in the amounts of mineralizing nodules. Analyzing the data in the non-linear function showed that the profile presented a decreasing trend with a negative angular coefficient. This profile agrees with the Hormetic model, in which low doses induce a stimulatory effect while high doses cause inhibition.

Conclusão:

This study is one of the first to investigate the action of low-dose gamma radiation on the MC3T3-E1 culture, focusing on potential applications in bone regeneration therapy.

Apoio Financeiro:

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