# 3 - 96 Effects of $^{12}C^{6+}$ Ion Radiation on Zebrafish Embryonic Oxidative Stress Response and Gene Expression

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Radiation exposure can cause various biological injury effects, including cellular lethality, mutations, carcinogenesis and the after-effects of biological genetic toxicity. The damage affects crucial biomacromolecules mainly because the ray energy is absorbed by small surrounding molecules, primarily water, that produce considerably more reactive oxidative species (ROS). These free radicals have high biological activity and a very short lifetime. However, excess free radicals can induce oxidative damage to intracellular biomacromolecules (DNA, protein and biomembranes)[1], break the balance between oxidation and the antioxidant defense system, induce oxidative stress and then cause bodily injury at the molecular, cellular and tissue levels[2]. Thus, the organism must have protective mechanisms for the removal of excess free radicals and evolved diverse protective systems to enable adaptation to oxidative environments[3].

The effects of carbon ion irradiation on the induction of oxidative stress and alteration of gene expression were studied in zebrafish (Danio rerio) embryos. Zebrafish embryos at 8 hpf were divided into four groups: the control group; the 1, 3 and 7 Gy irradiation groups. In the irradiated groups, a significant increase in the teratogenesis of the zebrafish embryos and oxidative stress was accompanied by increased malondialdehyde (MDA) content, decreased glutathione (GSH) content and alterations in antioxidant enzyme activities (such as catalase [CAT] and superoxide dismutase [SOD]). Moreover, the mRNA levels for Cu/Zn-sod, Mn-sod, cat and gpx, the genes encoding these antioxidant proteins, were altered significantly. However, the mRNA expression patterns were not in accordance with those of the antioxidant enzymes and were more sensitive under low-dose irradiation. In addition, we detected the mRNA expression of ucp-2 and bcl-2, which are located at the mitochondrial inner membrane and related to reactive oxidative species (ROS) production. In the irradiated groups, the mRNA level of ucp-2 was significantly increased, whereas the mRNA level of bcl-2 was significantly decreased. Overall, this study provided helpful information about the transcriptional effects of irradiation to better understand the mechanism of carbon ion-induced oxidative stress.

## References

[1] S. J. Neill, R. Desikan, A. Clarke, et al., J. Exp. Bot., 53(2002)1237.
[2] R. Roots, S. Okada, J. Radiat. Res., 64(1975)306.
[3] G. Noctor, C. H. Foyer, Annu. Rev. Plant Physiol Plant Mol. Biol., 49(1998)249.