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Combined Effects of Ionizing Radiation and Nanoparticles on Radiosensitive Yeast Cells

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There are several lines of experimental proof that nanoparticles (NPs) have toxicity on various organisms. In general, NPs are defined as particles having one dimension below 100 nm. It has been reported that both TiO2 and ZnO NPs had toxicity to several prokaryotic cells such as and gram-negative Escherichia coli and gram-positive Basillus subtilis. In the meanwhile, ionizing radiation induces biological damage directly as a result of deposition of energy in cells or indirectly as a result of free radicals formation and oxidative damage. DNA, protein, lipid and other biomolecules can be denatured during exposure to high energy of ionizing radiation. This study was performed to evaluate the effects of combined treatment of TiO2 or ZnO NPs with gamma-rays on the growth of a radiosensitive strain Saccharomyces cerevisiae W303-1A which contains a mutant allele of YBP1, ybp1-1, encoding four amino acid substitutions which are responsible for an increased peroxide sensitivity, and consequently for an increased radiosensitivity. The yeast cells were treated with TiO2 and ZnO NPs and 10 Gy and 30 Gy gamma rays. The relative survival rate of the yeast cells after treatment with ZnO NPs decreased with increasing concentrations of NPs, while TiO2 NPs resulted in a slight increase in cell death. The combined treatment of NPs with gamma-rays did not significantly increase the death of the yeast cells. In conclusion, TiO2 is much less toxic to eukaryotic yeast cells than ZnO, while TiO2 is more toxic than ZnO to prokaryotic cells.

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