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Important Role of Redox Enzymes in Protection against Oxidative Stress in *Escherichia coli*

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Thioredoxin is a small, heat stable, redox-active protein present at high concentrations in cells. Many different functional roles have been characterized from a wide variety of prokaryotic and eukaryotic cells. From these functions and its distribution in cells, it has been strongly suggested that thioredoxin must play an important role in protection against oxidative threat. However, there is no direct indication that the deficiency in the thioredoxin, e.g., with mutations in thioredoxin and thioredoxin reductase genes, sensitizes cell to oxidative stress. Recently, it is reported that thioredoxin can protect E. coli cells from the damage caused by gamma-radiation under certain metabolic conditions. But the mechanism for the protection by thioredoxin is not understood. Hence, we examined whether thioredoxin, thioredoxin reductase and another kinds of redox enzymes might also serve to protect E. coli cells from other oxidative stress such as hydrogen peroxide.

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Large Isotope Effect on Reaction of Vitamin C and Long-lived Radicals in γ-Irradiated Protein Solution (a Model of Cells). Tunneling Reaction in Biological System.

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Reaction of vitamin C (or deuterated vitamin C) and long-lived radicals has been studied in γ-irradiated aqueous albumin solution, i.e. a model of cells, by ESR. The long-lived radicals cause some type of DNA mutations in γ-irradiated human cells. The significant isotope effect on the reaction (k_H/k_D=20 $\sim$50) has been observed. The large isotope effect suggests that the reaction of vitamin C is caused by a quantum-mechanical tunneling effect. This is probably the first example of tunneling reaction in a biological system.

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ESR Studies on Reaction of Metallothionein and Long-lived Radicals in Murine Liver.

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When mice are pretreated with injection of manganease salt or excision of their skin, they obtain marked tolerance to radiation, and levels of hepatic metallothionein (MT) increase drastically. In order to elucidate this phenomena, we studied the reaction of radicals with MT in vivo by using ESR spectrometer. There exists organic radicals with long lifetime in mice liver. In spite of the increase of MT levels by the various pretreatments to mice, the concentration of the organic radicals in liver is kept to be constant at 2 nmol g^{-1}, while MT reacts with the organic radicals by the rate constant of 40 dm^3 mol^{-1} s^{-1}.