Oxidative stress – repair systems of oxidatively damaged biomolecules

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ABSTRACT

Molecular oxygen (O_2), constituting the basis of life on Earth, is classified as a substance with oxidizing properties. Reacting with organic compounds, it leads to their oxidation and at the same time participates in reduction processes. In aerobic organisms, over 90% of oxygen undergoes a total four-electron reduction to produce water molecules ($O_2 + 4\ H^+ + 4e^- \rightarrow 2\ H_2O$). The remaining 10% of oxygen, however, is not fully reduced, which results in the production of molecules referred to as reactive oxygen species (ROS). In high concentrations ROS can interact with cellular components (DNA, proteins and lipids), leading to the oxidation of these macromolecules. The resulting oxidation products interfere with the proper functioning of the body by influencing gene expression, intercellular signaling and apoptosis. These changes have been observed in numerous pathological conditions, such as neurodegenerative, cardiovascular, metabolic, autoimmune diseases, and cancer. However, in the context of evolution, living organisms developed specialized repair mechanisms to prevent cellular accumulation of the products of DNA, protein and lipid oxidation, including enzymatic mechanisms (e.g. nucleases, proteases, phospholipases) or removal of damaged DNA, proteins and lipids by apoptosis or autophagy. This article briefly discusses the mechanisms of oxidative modification of cell components and the main repair systems responsible for the removal of lesions in cells by oxidative damage.

Keywords: oxidative stress, oxidative damage, oxidative stress repair systems

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