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Commentary

Formation of Hydrogen Peroxide in Mammalian Cells

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DESCRIPTION

Hydrogen peroxide (H_2O_2) is a compound engaged with a few mammalian reactions and processes. It balances and signals the redox metabolism of cells by acting as a messenger along with Hydrogen sulfide (H_2S) and Nitric oxide (•NO), initiating specific oxidations that controls the metabolic reaction. There are multiple ways to produce H_2O_2 in cells, and cellular systems strongly control its concentration. At the cell level, the collection of hydrogen peroxide can activate inflammation and even apoptosis, and when its concentration in the blood arrives at toxic levels, it can prompt bioenergetic failure. Hydrogen peroxide H_2O_2, otherwise called dioxygenase or dioxygen, is a strongly oxidizing compound with an especially unpleasant smell that deteriorates into oxygen and water, liberating a lot of heat. In spite of the fact that non-combustible, a solid oxidizer can cause combustion when it comes into contact with organic material or metals, for example, copper, silver or bronze. Due to its chemical properties, hydrogen peroxide is utilized in numerous areas of human activity, like medical services, as an antiseptic, antimicrobial and antibacterial agent.

In mammals, in respect of redox signaling and regulation, H_2O_2 is an endogenous oxidant. At micromolar concentrations, H_2O_2 is reactive, and at high concentrations, it can harm the energy-changing cells, e.g., by inactivating the glycolytic catalyst glyceraldehyde-3-phosphate dehydrogenase. In the Fenton reaction, solvent Fe (II) gives an electron to an H_2O_2, making it break down into hydroxyl radicals •OH^+ $^-$OH. Until a few years ago, H_2O_2 was viewed as an undesirable and harmful product for metabolism since it is a result of oxidative stress in cells. All things considered, it has come to the front lately as a key redox signalling molecule in various biological cycles, including cell separation and proliferation, inflammation, tissue fixation, and circadian beat.

Hydrogen peroxide is formed as a result of the monovalent reduction of superoxide or by the divalent reduction of oxygen. The primary source of hydrogen peroxide is enzyme-catalyzed superoxide dismutation, however, it can also result from the two-electron reduction of oxygen in a reaction catalyzed by oxidases like xanthine oxidase, glucose oxidase, amino acid oxidase, urate oxidase, and others. Since hydrogen peroxide is uncharged with a pKa≈10.8 at neutral pH, it can undoubtedly enter biological membranes. Hydrogen peroxide is a strong oxidant, yet because of its slow reaction energy with the biomolecules, it is relatively unreactive. H_2O_2 is able to oxidize numerous particles and inactivate specific enzymes with the thiol group or methionine deposits in their active site.

It has been known for over 60 years that hydrogen peroxide forms in living creatures. H_2O_2 is not a free radical, yet it is a reactive type of great importance that it can form the hydroxyl radical. In mammalian cells, two types of H_2O_2 production exist together, characterized as an enzymatic and non-enzymatic generation. Basically, the non-enzymatic one is derived from the reduction by e^- and H^+ of the O_2^- anion, which comes from the reduction of O_2 in the mitochondrial respiration pathway. The enzymatic pathway begins from the •O_2− anion and includes the enzyme superoxide dismutase, SOD1, SOD2 and SOD3. In HSCs, overactivation of oxidative stress pathways advances the production and intracellular gathering of •O_2^- and H_2O_2 severely disturbs the biological functions of HSCs and plays a significant part in leukemia progression.

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