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A mitochondrial superoxide theory for oxidative stress diseases and aging

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Abstract

© 2015 JCBN. Fridovich identified CuZnSOD in 1969 and manganese superoxide dismutase (MnSOD) in 1973, and proposed "the Superoxide Theory," which postulates that superoxide (O2 -) is the origin of most reactive oxygen species (ROS) and that it undergoes a chain reaction in a cell, playing a central role in the ROS producing system. Increased oxidative stress on an organism causes damage to cells, the smallest constituent unit of an organism, which can lead to the onset of a variety of chronic diseases, such as Alzheimer's, Parkinson's, amyotrophic lateral sclerosis and other neurological diseases caused by abnormalities in biological defenses or increased intracellular reactive oxygen levels. Oxidative stress also plays a role in aging. Antioxidant systems, including nonenzyme low-molecular-weight antioxidants (such as, vitamins A, C and E, polyphenols, glutathione, and coenzyme Q10) and antioxidant enzymes, fight against oxidants in cells. Superoxide is considered to be a major factor in oxidant toxicity, and mitochondrial MnSOD enzymes constitute an essential defense against superoxide. Mitochondria are the major source of superoxide. The reaction of superoxide generated from mitochondria with nitric oxide is faster than SOD catalyzed reaction, and produces peroxynitrite. Thus, based on research conducted after Fridovich's seminal studies, we now propose a modified superoxide theory; i.e., superoxide is the origin of reactive oxygen and nitrogen species (RONS) and, as such, causes various redox related diseases and aging.

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Keywords

Mitochondria, MnSOD, Oxidative stress diseases and aging, ROS, Superoxide theory