Journal of Pollution Effects & Control

OPEN ACCESS Freely available online

Opinion

# Oxidative Stress: Harms and Benefits for Human Health

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## INTRODUCTION

The potential function of oxidative stress in the creation of tissue damage in diabetes mellitus is explored. Oxidative stress is defined as a disruption in the equilibrium between the formation of reactive oxygen species (free radicals) and antioxidant defences. The biological origins of important free radicals are examined, as well as the key antioxidant defence systems. There are several examples of the effects of free radical damage, with a focus on lipid peroxidation. Finally, the subject of whether diabetes mellitus causes an increase in oxidative stress is examined.

Reactive oxygen species (ROS) include superoxide radicals ($O_2$), hydrogen peroxide ($H_2O_2$), hydroxyl radicals (OH), and singlet oxygen, which are produced as metabolic by-products by biological systems. Protein phosphorylation, transcription factor activation, apoptosis, immunity, and differentiation are all dependent on correct ROS generation and presence inside cells, which must be regulated at a low level. When the formation of reactive oxygen species (ROS) grows, they begin to have negative effects on essential cellular components such as proteins, lipids, and nucleic acids. A growing amount of data suggests that oxidative stress has a role in the start and/or progression of a variety of illnesses (including cancer, diabetes, metabolic disorders, atherosclerosis, and cardiovascular diseases) $O_2$ can be produced by cellular respiration, lipoxygenases (LOX) and cyclooxygenases (COX) during arachidonic acid metabolism, and endothelial and inflammatory cells in both healthy and pathological situations. Although these organelles have an intrinsic ROS scavenging capability, it is important to emphasise that this is insufficient to meet the cellular demand to remove the quantity of ROS generated by mitochondria [1].

### Oxidants and Free Radical Production

Enzymatic and no enzymatic processes are primarily responsible for ROS generation. The respiratory chain, prostaglandin production, phagocytosis, and the cytochrome P450 system are all enzymes that can create ROS. NADPH oxidase, xanthine oxidase, and peroxidases produce superoxide radical ($O_2$). Once generated, it undergoes a series of reactions that result in hydrogen peroxide, hydroxyl radicals (OH), peroxynitrite (ONOO), hypochlorous acid (HOCl), and other products [2,3]. Multiple oxidase enzymes, such as amino acid oxidase and xanthine oxidase, create $H_2O_2$ (a nonradical). The most reactive of all the free radical species in vivo, the hydroxyl radical (OH), is produced by the interaction of $O_2$ with $H_2O_2$, using $Fe^{2+}$ or $Cu^{+}$ as a reaction catalyst (Fenton reaction). The nitric oxide radical (NO), which has several physiological functions. Even nonenzymatic events, such as when oxygen combines with organic molecules or when cells are subjected to ionising radiations, can produce free radicals. During mitochondrial respiration, nonenzymatic free radical generation can also occur .Both endogenous and external sources create free radicals. Endogenous free radical generation is caused by immune cell activation, inflammation, ischemia, infection, cancer, excessive exercise, mental stress, and ageing. Environmental contaminants, heavy metals (Cd, Hg, Pb, Fe, and As), certain medicines (cyclosporine, tacrolimus, gentamycin, and bleomycin), chemical solvents, cooking (smoked meat, used oil, and fat), cigarette smoke, alcohol, and radiations can all cause exogenous free radical generation . These exogenous chemicals are destroyed once they enter the body [4].

### Physiological Activities of Free Radicals

When kept at low or moderate levels, free radicals have a number of positive effects on the body. They are required, for example, to synthesis certain cellular structures and to be utilised by the host defence system in the fight against infections. In fact, phagocytes produce and store free radicals in order to be ready to release them when harmful bacteria entering the body need to be killed. Granulomatous disease patients are a good example of how important ROS is for the immune system [5]. Because they are unable to create $O_2$ due to a malfunctioning NADPH oxidase system, they are susceptible to various and, in most cases, chronic infections. A variety of cellular signalling pathways are also affected by free radicals.

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**Received:** December 09, 2021; **Accepted:** December 23, 2021; **Published:** December 30, 2021

**Citation**: King J (2021) Oxidative Stress: Harms and Benefits for Human Health. J Pollut Eff Cont 9:317. doi: 10.35248/2375-4397.21.9.322.

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