

Antioxidant protection of the human body

Metabolic processes produce reactive oxygen species (ROS) and reactive nitrogen species (RNS). All biologically important reactive forms of nitrogen also contain an oxygen atom, sometimes referred to as "reactive oxygen and nitrogen species" (RONS).

Reactive forms of oxygen and nitrogen

They include two groups of substances ^[1]:

Free radicals

They contain an unpaired electron, making them very reactive. Typical representatives are, for example, the hydroxyl radical $\cdot\text{OH}$, the superoxide $\text{O}_2^{\cdot-}$ or nitric oxide $\text{NO}\cdot$.

Non-radical reactive forms

Oxygen compounds (or oxygen and nitrogen) which, although not in their nature free radicals, can easily be formed by further reactions. These include, for example, hydrogen peroxide H_2O_2 or peroxynitrite ONOO^- .

Free radicals are formed in three different ways: by homolytic cleavage of a covalent bond, by reduction (addition of one electron) or by oxidation (loss of one electron). If a radical reacts with another normal molecule, it also turns it into a radical (propagation of a radical reaction). The radical reaction is completed by the reaction of two radicals. Free radicals damage fatty acids, lipids and proteins, but also contribute to the body's immune protection.

 For more information see *Basic reactive oxygen and nitrogen species*.

Benefit of free radicals in a healthy organism

The hydroxyl radical formed by the monooxygenase enzyme is important in the liver for the hydroxylation of xenobiotics, including drugs, and in the adrenal glands for the hydroxylation of steroids (formation of bile acids). Neutrophils and macrophages use reactive oxygen species (superoxide and hydrogen peroxide) to remove dead cell debris and to phagocytose bacteria. As an important local hormone and neurotransmitter, nitric oxide is involved in the relaxation of vascular smooth muscle, GIT and corpus cavernosum penis. It has an antiplatelet and antiadhesive effect on platelets and leukocytes and affects learning and memory in the CNS.

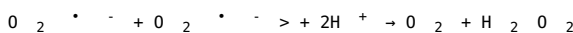
Antioxidant protection

The body prevents excessive exposure to free radicals in three ways. On the one hand, it prevents the formation of a large number of regulations enzymes that make them up. The second option is to capture and remove already formed radicals, in which enzymatic and endogenous antioxidants are involved. If the two previous mechanisms fail, the repair mechanisms of the damaged biomolecules apply.

Antioxidant enzymes

Superoxide dismutase

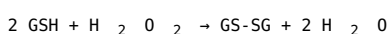
It is part of every cell. Catalyzes the dismutation of superoxide to dioxygen and hydrogen peroxide:



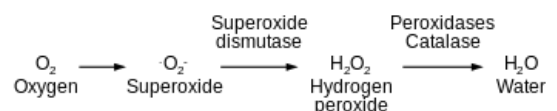
It is indispensable for life on our planet. It occurs extracellularly and in the mitochondria of eukaryotes and prokaryotes.

Glutathione peroxidase

Using glutathione protein, it reduces hydrogen peroxide to water:



It occurs in several forms, it contains selenocysteine in the active site.



Catalase

The tetramer, each containing one prosthetic protoporphyrin group with Fe^{3+} . It catalyzes the dismutation of hydrogen peroxide into oxygen and water. It occurs in peroxisomes and erythrocytes.

High molecular weight endogenous antioxidants

High molecular weight endogenous antioxidants are proteins capable of binding transition elements (iron and copper) and altering their redox properties to stop catalyzing radical reactions.

- transferrin / lactoferrin (weighs Fe^{3+});
- ferritin (storage of Fe^{3+});
- haptoglobin / hemopexin (*'binds circulating hemoglobin / heme'*);
- ceruloplasmin;
- albumin.

Low molecular weight endogenous antioxidants

- Ascorbate (vitamin C);
- Alpha tocopherol (vitamin E);
- Coenzyme Q;
- Carotenoids, Beta-carotene and Vitamin A;
- *'Thiols'* and *'disulfides'*;
- Uric acid, bilirubin.

Pathobiochemistry of antioxidant protection

If the formation of reactive oxygen species and nitrogen is greater than their removal, an imbalance called oxidative stress will occur.

Links

source

- ws:Antioxidační ochrana lidského těla

External Articles

- Free radicals, antioxidants and aging (<http://www.solen.cz/pdfs/int/2009/01/06.pdf>)
- Antioxidant effects of fruits and vegetables (https://is.muni.cz/th/asqtv/AuOZ_nove.pdf?so=nx) - Bachelor thesis in the field of human nutrition

Source

- ŠTÍPEK, S, et al. *Antioxidants and free radicals in health and disease*. 1. edition. Prague : Grada, 2000. 320 pp. ISBN 80-7169-704-4.
- PLÁTENÍK, Jan. *Reactive forms of oxygen in the human body Antioxidant protections* [lecture for subject Pathobiochemistry, specialization LEK, 1.LF UK]. Prague. 2011. Available from <<https://el.lf1.cuni.cz/p74867893?account-id=7&principal-id=1512062&session=breez96tipacpetw5kwci>>.

1. KIDNEY, Miroslav. *Biochemistry for medical students*. 1. edition. Karolinum, 2009. ISBN 9788024614144.