

Chapter 9: Free radicals and Antioxidants

*The smaller the stimuli and irritants, the larger the reactions!
"Atomic reactions can release a significant amount of energy
compared to the energy charge released by a dynamite explosion! ..."*

Some scientific theories explain the aging process in the body with the principle of action of free radicals. Recent scientific findings and reports link the intensive endogenous production of free radicals with the action of toxic bile acids, which, to one degree or another, suggests the role of destructive emotions in these processes. (p.12,33,44,108-112)

Free radicals are atoms, molecules or ions that are ready to react with other particles, causing various chemical reactions, producing reactive compounds and toxins in the body.

Antioxidants are molecules that can suppress the chemical reactions of oxidation of other molecules.

Pro-oxidants are chemicals that cause oxidative stress by producing ROS (reactive oxygen species) or by blocking the body's antioxidant defenses.

Oxidative stress is a condition of imbalance between the systemic manifestation of oxygen free radicals (ROS) and the body's ability to effectively neutralize (detoxify) the intermediate reactive compounds, or to repair the damage.

Vitamins, minerals and trace elements play an important role in maintaining the redox and detoxification status of our body.

Vitamins (p. 63) are directly involved as antioxidants or support the synthesis of antioxidant enzymes in the liver.

Minerals (p. 51) are the main guardians of the energy balance in the body. Due to their electrolyte potential, they drive and regulate cellular energy exchange, all intercellular and enzymatic reactions, and metabolic processes.

Trace elements (p. 63), despite their insignificant bioavailability, with their positive or negative ionic charge, play an important role in maintaining the redox balance, detoxification and immune status of the body. (p.168)

Free radicals (Oxidants)

Free radicals perform various biological functions: they cause the neutralization of bacteria and participate in redox processes at the cellular level. Most free radicals, of biological importance, interact with oxygen and form the so-called. reactive oxygen species (ROS): hydroxyl radical (-OH), hydrogen peroxide (H₂O₂), superoxide radical (O₂⁻), nitric oxide (NO•), etc. ROS can be formed as a natural product of cellular metabolism and play an important role in biochemical balance.

ROS can be generated in the body and under the influence of external irritants such as: pollutants, cigarette smoke, drugs, xenobiotics (foreign toxic particles), radiation, incl. ultraviolet UVA and UVB rays. Ionizing radiation, for example, can form high levels of ROS in the body, by radiolysis, causing the breakdown of water molecules. High amounts of ROS at the cellular level can cause oxidative stress and tissue damage. Some of the dangerous oxidative reactions are lipid peroxidation and inactivation of important enzymes that lead to cell membrane destruction, oxidation of cell DNA, amino acids and polyunsaturated fatty acids, formation of toxins. (str.22,34,64-65)

Oxidative stress

Disturbances in the normal oxidative status of the cell can cause toxic effects, such as excessive production of free radicals or peroxides, which damage all cellular components, including proteins, lipids and DNA.

Biomarkers of oxidative stress in the body may be reduced levels of natural antioxidants, such as glutathione, or the presence of reactive intermediates. (p.54,62-64,79,127) For example, compounds such as malondialdehyde, isoprostanes, hydroxyalkenal, are obtained from the breakdown of polyunsaturated fatty acids in the stomach, colon, adipose tissue and lymph, under the influence of reactive bile acids (p. 109,111) circulating in the entero-hepatic cycle. These intermediates not only cause inflammation, but can exhibit mutagenic and even carcinogenic properties, replicating damage to neighboring tissues by provoking uncontrollable oxidative reactions.

Specific markers of oxidative stress are found in conditions of impaired metabolism, but also in various inflammatory, allergic, fibrotic and degenerative processes, causing disorders in the respiratory, cardiovascular, neuromuscular and digestive systems. (p.55) Manifestations of chronic oxidative stress are observed in various physiological conditions and diseases, mainly with impaired metabolic, alkaline-acid and immune status, such as: overweight, cellulite, diabetes, arthritis, atherosclerosis, gout, asthma, Alzheimer's, psoriasis, insulin resistance; in some energy disturbances related to the liver, kidneys and lungs. (p. 27,33,50,128,190)

Oxidation-reduction (Redox) balance

Maintaining emotional, mental and physical balance in the body is extremely important in today's everyday life, in which we are permanently exposed to various internal and external stimuli and influences. Science is finding more and more close links between different emotions and the reactivity of redox processes at the cellular level. These are probably due to the properties of water and the recent discovery that it has a memory. It is interesting to find, for example, that systemic low levels of stress maintain antioxidant and immune defenses in the body. (p.32,36,68,85,90) Another scientific finding shows that stimulated production of free oxygen radicals in cancer cells reduces their resistance, and can cause their cell death without causing adverse oxidative reactions in neighboring healthy cells.

Oxidation-reduction reactions are vital for the production of energy in cells and the performance of vital functions of the body. (pp.22,44-45) Oxidants are produced as a result of normal cellular function, and antioxidants are needed to control their overreactivity. For example, during intense physical training, the body releases a number of free radicals, which in time trigger the natural antioxidant defenses. (p.64) In an untrained body, or in depleted levels of natural antioxidants, it will take several days to neutralize the harmful oxidative action known as "muscle fever" due to the deposition of lactic acid by muscle work. (pp.76-79) The import of vitamins and antioxidants at such a time can hardly have a positive effect, and can even slow down the natural antioxidant defenses, contributing to oxidative stress. (p.46,54,86,128-130)

In order to avoid oxidative stress, it is necessary to constantly take care of the redox balance at the cellular level, nourishing our body with the necessary daily needs of useful substances, cheerful emotions and bright thoughts. (p.51,70,88-92)

The table on pages 64-65 discusses the damage caused by free radicals, as a result of some of our ordinary activities and conditions in everyday life, and the antioxidants needed to neutralize them. Therefore, when we feel physically or mentally unwell, it is good to take a short break or take unloading activities before succumbing to the negative emotions provoked by our "sour" states. (p.36,102,105,112,131)

ANTIOXIDANTS

Antioxidants are molecules that can suppress the oxidative reactions of other molecules. Oxidative reactions are important for the vital balance in the body, but can cause cell damage in the case of high levels of ROS and insufficient presence of antioxidants, ie. under conditions of oxidative (genotoxic) stress. (p.49)

The antioxidant protection of our body is performed by: (p.53,63,64,82,85)

- **antioxidant enzymes:** catalase, superoxide dismutase, peroxidase, and
- **antioxidant metabolites** naturally synthesized in the liver (p.106), with the help of bile and kidney functions: (p.25,51,63,73,95, 108,111,127) glutathione, melatonin, biliverdin, glucuronic and uric acids,
- **but also from plant antioxidants imported with food** - vitamins C, E, A and other phytochemicals (flavonoids, polyphenols, carotenoids, tocopherols), which often give the taste, smell and color of fruits, vegetables and herbs. (p.23,63,168)

A number of minerals and trace elements are involved in antioxidant protection: iron, zinc, selenium, copper (p.63,136), magnesium and electrolytes (p.51), which we supply with food, mainly through vegetables, nuts, grains and dairy products, but and with some widely used herbs and spices. (p.54,59,168)

Antioxidants work by:

- reduction of oxidative processes, or by
- inhibition of oxidative reaction, or
- direct elimination (detoxification) of free radicals.

Some compounds (chelators) bind free metal ions, and thus block their ability to produce free radicals and oxidative reactions, helping the body's antioxidant defenses.

We often believe that the more vitamins, minerals and trace elements we take in addition to those with food, the healthier, rejuvenated and energetic we will become, without assuming that we can upset the balance. (p.43,54,59,169)

There are periods in our life when biological processes (growth, pregnancy, aging), stress or an irregular lifestyle, eat the nutrients in our body, and then we really need additional imports. However, it is necessary that the supplement of these substances be taken with caution, never for no reason, and if possible supplied with plant foods. (p.23,51,76,128,168)

PRO-OXIDANTS

Pro-oxidants are chemicals that potentiate or cause oxidative stress, through the production of ROS, or by blocking the body's antioxidant defenses. Pro-oxidants can interact with free (reactive) metal molecules (such as iron, copper, chromium, vanadium, cobalt), which in turn can act as catalysts for lipid peroxidation, or the oxidation and breakdown of proteins. (p.34,58,136,159)

Some antioxidants that are involved in the reduction processes of cellular metabolism may also have pro-oxidant (oxidative) effects: ascorbic acid (vitamin C), tocopherol (vitamin E), carotene (vitamin A), uric acid, polyphenols, flavonoids and others. (p.43-45,47-48,63)

The "dual" nature of certain antioxidants is often manifested in conditions of oxidative stress, or in the appearance of various pathogens and xenobiotics. In this way, they mobilize the protective functions of the immune system in order to maintain balance in the body. (p.82,85,162)

On the next page we will look at the 13 vitamins involved in antioxidant protection and the 12 essential trace elements that maintain redox status and the body's natural detoxification. A balanced diet provides the necessary daily needs for these elements. (p.63,166,168-169)