MECHANISM OF ANTIOXIDANTS PREVENTING OXIDATIVE STRESS

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The vital processes of the organism are inextricably linked with the formation of reactive oxygen metabolites (ROS) of radical and non-radical origin, which are intermediate products of the four-electron reduction of oxygen to water. ROS participate in two main processes: on the one hand, the implementation of the body's defense mechanisms; on the other hand, excessive formation of ROS and their secondary products leads to a state known as oxidative stress. The development of oxidative stress in the body is prevented by substances with antioxidant properties of endogenous and exogenous origin. Today, it is difficult to find a single area of medicine, biochemistry, biophysics, pharmacy or food technology that would not study free radical oxidation and the antioxidant effect. The study of the antioxidant properties of substances is interdisciplinary and is aimed at improving human health and increasing life expectancy. One of the current directions in this field is the development of approaches to determine the integral parameters of antioxidant and antiradical capacity/activity, since the effectiveness of the body's antioxidant system may not be related to the content of a particular compound, but rather reflects the properties of the entire system.

The interest in studying the antioxidant properties of various objects is due to a number of factors related to the consumption of molecular oxygen by living organisms. Approximately 90% of the molecular oxygen inhaled by humans is involved in metabolic pathways, in which the energy generated during the oxidation of nutrients is stored in the mitochondria of cells as adenosine triphosphate (ATP). This process, called oxidative phosphorylation, provides the body with energy. In addition, along with this important process, all living organisms undergo reactions that form activated oxygen metabolites (AOM) from molecular oxygen, for example, O2•-, HO•, RO•, H2O2, ROO•, 1O2, OCl-, NO•, ONOO-, NO2• [1]. In the process of evolution, all living organisms have developed entire enzymatic systems that participate in one-, two-, and four-electron reduction reactions of molecular oxygen (Fig. 1) [2, 3].

According to Helmut Esterbauer [4], a human consumes 17,000 kg of molecular oxygen during a 70-year lifespan, during which time 800 to 1700 kg of activated oxygen metabolites (AOM) are produced.

Antioxidants protect cells from oxidative damage by neutralizing free radicals and reactive oxygen metabolites produced in the body. Their main mechanisms of action are based on the processes of electron or hydrogen atom transfer, stopping chain oxidation reactions, and binding metal ions. These mechanisms are important in maintaining the structural integrity of cell membranes, proteins, and DNA.

The role of oxidative stress in the development of many pathological conditions indicates the need for a deep study of the antioxidant system. The development of methods for the integral assessment of antioxidant/antiradical capacity, especially based on potentiometric approaches, allows for a more accurate assessment of the activity of substances in real biological conditions. Quantitative analysis of electron and electron-proton transfer reactions using model oxidizing systems serves to determine antioxidant efficiency by objective indicators.

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