PEROXIDASE ACTIVITY OF CARDIOLIPIN AND CYTOCHROME *C* COMPLEX AT QUASI-STATIONARY APPROXIMATION FOR ITS REACTION STATES

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At the present time, the intensive growth of biotechnologies is due to the active implementation of physical research methods in many areas of bioscience and medicine. This significantly expands the possibilities of biochemical methods of analysis and leads to the discovery of new biochemical phenomena. In particular, the experimental detection of peroxidase activity in the cytochrome *c* (Cyt) and cardiolipin (CL) complexes is based on the use of such physical methods as the chemiluminescence analysis and EPR spectroscopy, which provide biochemists with broad research opportunities both *in vivo* and *in vitro*. It should be noted that, the Cyt-CL complexes are the biocomposite systems formed in the cell membranes (CMs) and in their artificial analogues derived from the lipid mono- and bilayers, having a flat or spherical shape. In turn, the CMs of animals and plants belong to one of the widest classes of the natural composite biosystems. So, according to the mosaic model, it has a lipid layer as a supporting base, the surface and inner part of which contains a mosaic of disordered inclusions from various protein molecules (performing the transport, signaling, channel-forming and catalytic functions). Also, the lipid bilayer, which consists of various saturated and unsaturated lipids, is in itself a disordered mosaic of nanoscale fragments that have a liquid crystalline structure and vary in the size and composition. Thus, the studies of the properties and structural features of composite biosystems (natural and artificial) as well as of the various processes and phenomena in them are extremely important for the development of medicine and pharmacology, because such studies stimulate the elaboration and creation of different biocomposite materials with the desired properties.

The given work is devoted to the theoretical study of the peroxidase activity of the Cyt-CL complexes, due to which the process of lipid peroxidation (LPO) occurs in the mitochondrial membranes (MMs). As known, a formation of the Cyt-CL complexes, which manifest a quite high peroxidase activity, both *in vivo* (in the MMs) and *in vitro* (in the artificial analogs of CMs based on the lipid layers) has been proven experimentally (details on the composition, the structure and causes of the peroxidase activity of Cyt-CL complexes are presented in the review [1]). In whole, a kinetics of the LPO process, as follows from an analysis of the general reaction scheme consisting of 22 reactions that occur on two reaction pathways (enzymatic and non-enzymatic), is described by a model system of differential equations (DEs) relative to the concentrations of reagents, as shown in [1]. The contribution of lipid antioxidant in the LPO kinetics was also taken into account. The obtained DE system allows to determine and compare the effectiveness of the action of various lipid antioxidants on the LPO process, performing the numerical simulation and comparing of the yields of the lipid oxidation products; to find the unknown rate constants for some reactions, using the existing experimental data; to evaluate the peroxidase activity of the Cyt-CL complexes, which include different types of cardiolipin. In conclusion, we note that in this work, the analysis of quasi-stationary approximation was carried out for various reaction states of the Cyt-CL complex (inactivated – E1 and two activated – E2 and E3). The performed analysis shows the possibilities of implementing different quasi-stationary regimes for the Cyt-CL complexes that are involved in the LPO process. A role of the lipid antioxidant in the setting and bias of these quasi-stationary regimes is also analyzed.

[1] E.Yu. Kanarovskii, O.V. Yaltychenko, and N.N. Gorinchoy, *Surface Engineering and Applied Electrochemistry*, 2018, **54**(5), pp. 481–497.