MATHEMATICAL MODELS OF OXYGEN-BINDING FUNCTION OF HUMAN HEMOGLOBIN MODIFIED WITH NITROGEN OXIDE, IN CONDITIONS OF THE UV-IRRADIATION

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Nitrogen oxide (NO) plays the important role in modulation of hemodynamic and oxygenation of human and animal tissues and organism. Researches of the influence of NO and UV-irradiation on functional properties of human hemoglobin and mathematical modeling of processes of interaction of intact and modified hemoglobin with O_2 represent significant theoretical and practical interest. It has been revealing, that function of saturation of Hb by O_2 submits to S-shaped dependence, which is described by Ferhulst equation:

$$Y=a_0+a_1/(1+a_2e^{a_3x}) \quad (1),$$

where Y - a degree of saturation of Hb by O_2, %;X - partial pressure of O_2, mm Hg; a_0, a_1, a_2, a_3 - the factors subject to definition.

UV-irradiation in dozes 151 and 453 J/m^2 does not cause basic change of character of dependence of function of saturation in comparison with not irradiated sample: the increase in speed of saturation process is marked.

Presence at researched samples HbNO in concentration 0,1; 1,0; 5,0 and 10,0 % resulted in essential updating oxygen-binding functions of hemoprotein. It has been revealed, that HbNO makes active the initial stage of oxygenation and weakens hem-hem interactions in molecule. Dissociation curves of the Hb modified with NO, are described polynoms of 4-th - 6-th degree depending on concentration of the modifying agent:

$$Y=\sum_{i=0}^{n}(a_ix^i) \quad (2),$$

at n=6 for [HbNO]=0,1%, n=5 for [HbNO]=1,0%, n=4 for [HbNO]=5,0%, n=6 for [HbNO]=10,0%.

The influence of UV-radiation in dozes of 151 and 453 J/m^2 on a mix containing 0,1 % of HbNO caused intensification of the initial oxygenation stage. The increasing of HbNO concentration in samples up to 1,0 - 10,0 % did not lead to the statistically authentic changes of parameters of hemoprotein oxygenation after UV-modification. However, saturation curves of UV-irradiated mixes HbO_2 and HbNO (except for a mix of 10 % HbNO and 90 % HbO_2, irradiated in a doze 453 J/m^2) are described by the logistical equations, as well as oxygenation curves of native and photomodified HbO_2:

$$Y=a_0+a_1/(1+a_2e^{a_3x}) \quad (3).$$

Therefore, modification of oxygen-binding function at the influence of HbNO has convertible character and is corrected by UV-radiation.

Differences of settlement saturation parameters of samples of human hemoglobin from experimental data do not exceed 5 % that allows using the offered mathematical models in practice.