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The properties of water in the RBC membranes according to dielectric measurement: effect of radiotherapy

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The state of cells and their reaction in the stress load in diagnosis and treatment is expressed in a change in the ratio of free water and water bound in the macromolecules of the cell membranes [1-2]. This ratio affects the complex value of the permittivity, since in bound water the mechanical moment is determined by the mass of the macromolecule. The most informative such measurements will be in the frequency range, including the frequency of free water relaxation, which determines the relationship between bound and free water and involves measurements in the frequency range of relaxation of water molecules, i.e. near the frequency of 10 GHz [3-5].

In this paper, we consider the effect of radiotherapy X-ray (total focal dose 45-50 Gy), by microwave dielectrometry method (f = 9.2 GHz), on the state of water in membranes of cells on the models of red blood cells (RBC) of patients with lung cancer, breast cancer, stomach cancer and healthy donors. The temperature-dependent differences, in the distribution of absorbed energy in cells were experimentally determined. The generalized results made it possible to calculate the relative values of transmembrane potentials near the cell membrane with a layer of bound water in two molecules thick on the inner and outer surfaces of the cell membrane. Estimation of hydration energy of bound water predicted by the model calculations shows an increase in the number of bound water regions in contact with the membrane or inside the membrane of state of oncology, in accordance with the volume percentage of bound water, which leads to a spatial change in the average number of hydrogen bonds per water molecule.

The results presented suggest that the change in the dielectric parameters of the RBC is associated with an overall increase in the defect in membranes RBC of cancer patients. This effect is exacerbated by ambient temperature, probably due to the local, temperature-dependent transitions of the lipid components of the membranes.

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