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A COMPARISON OF THE DIELECTRIC PROPERTIES OF HEMOGLOBIN BEFORE AND AFTER RADIOTHERAPY

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As known, the hemoglobin performs the vital function of carrying oxygen from the lungs to the tissues and facilitates the transport of carbon dioxide from the tissues to the lungs. The dielectrically permittivity of red blood cells has been found to depend on the hemoglobin and water content, temperature and the frequency relaxation of molecules of water in cells (Farsaci F., Ficarra S., Galtieri A., et all., 2017). In general each cell contains an intracellular fluid surrounded by a membrane. The packed blood cells have therefore been known to behave as a heterogeneous medium. In the radio frequency range the dispersion exhibited by such a medium has often been explained by the Maxwell-Wagner model and it has been suggested that it originates mainly from the polarization effects in which the cellular membranes are charged through the electrolytes (Batyuk L., Kizilova N., 2018).

In this paper the dielectric properties of aqueous hemoglobin solutions of donors and oncological patients are investigated under a variety of parameters, and the results are discussed in terms of the most probable orientation polarization. The study used the blood of 10 donors and 10 cancer patients with breast cancer. The group received postoperative radiation therapy in the mode of classical fractionation, a single focal dose per tumor was 6 Gy, and a total focal dose was 45 Gy. Blood sampling was performed before and after irradiation. The human hemoglobin was prepared by method (Casimir W. V., Kaiser N., Keilman F., et all., 1968). All measurements were done using UHF-dielectrometry method the temperature dependencies of the dielectric permittivity for water molecules and the relation of free and bound water. The complex dielectric constant of aqueous hemoglobin solution was measured at frequency 9.2 GHz. The temperature was varied from 20 to 37 °C. For all samples linear dependence of both real and imaginary part of dielectric constant of hemoglobin solution on concentration was found. The shift in relaxation wavelength and hydration ratios was calculated. We found that the frequency of relaxation time the molecule is determined mainly by the type of procedure of radiotherapy and by the viscosity of the solution, which is also responsible for the temperature and concentration dependence.

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