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EIGHTH INTERNATIONAL CONFERENCE ON RADIATION IN VARIOUS FIELDS OF RESEARCH

BOOK OF ABSTRACTS

2020 | Virtual Conference

Study of the dielectric properties of erythrocyte hemoglobin in patients with lung cancer before and after radiation therapy

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The study of the temperature behavior of the dielectric permittivity and conductivity the cells of the blood in the temperature range from 0 to 50° C is of great interest. Oxygen carriers - blood hemoglobin Hb and muscle hemoglobin Mb are well-studied proteins with a known spatial structure. Currently, the functioning of hemoglobin as reducing agents in biological systems of cells may be an important link in connection with the identification of the role of cellular proteins in maintaining the redox potential of the cell and overcoming oxidative stress during radiation exposure to the body during the treatment of the tumor.

In this paper the use of UHF-dielectrometry method makes it possible to differentiate bound water in the hydration shell of red blood cell hemoglobin according to structural and energy characteristics. Patients with lung cancer received radiation therapy as an independent course in the mode of classical fractionation (total dose of 45-50 Gy), with a single focal dose of 1.8-2.2 Gy. Radiation therapy was performed using gamma radiation ^{60}Co. Blood sampling was performed before and after irradiation. The complex dielectric constant of aqueous hemoglobin solution was measured at frequency 9.2 GHz. The temperature was varied from 5 to 42 °C.

The authors found that the temperature dependences of the dielectric permittivity of hemoglobin suspensions for donors and patients in the studied temperature range are characterized by nonmonotonic changes in dielectric permittivity and dielectric losses and a significant increase of the frequency of dielectric relaxation of water molecules of hemoglobin suspensions of patients in comparison with the frequency of dielectric relaxation of water molecules in the hemoglobin suspensions of donors.

In the suspensions of hemoglobin of donors and cancer patients there is a change in the activation energy of the dielectric relaxation time of water molecules on seven temperature intervals. The observed breakpoints of the Arrhenius dependences lie in the range of temperatures known as critical, where the rates of many physiological processes associated with erythrocyte hemoglobin change.

Monitoring of changes in enthalpy values in hemoglobin suspensions in cancer patients provides additional information about the course of the tumor process, which is of interest in connection with the development of methods for early diagnosis of malignancies.

The results of the dielectric permittivity of hemoglobin for cancer patients after radiation therapy show that the main fraction of water near the protein surface, the so-called bound water, is not at all immobilized what is connected involve a breaking and formation of hydrogen bonds.