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Influence of N20 and Ethanol on the Chemical Stage of Radiobilogical Mechanism

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The biological effect of ionizing radiation may be rather strongly influenced by the presence of other substances in corresponding medium during irradiation; see the problem of oxygen effect in tumor radiotherapy (at lower LET values). The radicals HO2 arising in diffusing radical clusters formed mainly by densely ionizing ends of secondary electrons are responsible for the enhanced effect in damages of DNA molecules. Their frequency in the dependence on oxygen concentration will be presented, having been established with the help of our model based on the use of Petri nets. There are, of course, other substances (radiosensitive as well as radioprotective) that may influence the radiobiological effect and be practically applied too. We have chosen two of them: N2O and Ethanol (acting in opposite ways). Molecules N2O react with hydrated electrons to form OH radicals which increase DNA damage while Ethanol acts as scavenger of radicals and lowers DNA molecule damage.
To create the mathematical model which describes physical and chemical processes in the chemical stage of radiobiological mechanism we have used Continuous Petri nets. It enables us to describe and study the influence of both the main parallel processes: chemical reactions and diffusion of radical clusters. It is possible to study the time change of concentration of individual radicals during this diffusion process, which may be very helpful when the efficiency of different substances present in medium in the DNA damage (radiobiological effect) is to be studied. Concurrently, Petri nets enable us to simulate dependences of radical concentrations on concentration of oxygen, N2O and Ethanol which may be very helpful to study influences of those substances on DNA damage and find out their optimal concentration for radiotherapy and protection of cells against ionization radiation. We have started to study the corresponding problem earlier with the help of analytical model where system of differential equations has been used. The given model has been applied to the experimental data obtained for Co60 radiation. The results of this model have been used for setting of basic parameters of Petri nets model.

Country/Organization invited to participate

Czech Republic

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