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C₆₀-CONTAINING NANOCOMPOSITES AS CATALYTIC SYSTEM FOR REACTIVE AS CATALYTIC SYSTEM FOR REACTIVE OXYGEN SPECIES GENERATION IN CELLS

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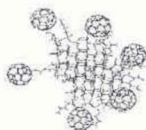
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Finding of a new nanoparticle systems suitable for manipulation at cell molecular level is the urgent problem of bionanotechnology. The representatives of a new allotropic form of carbon – C₆₀ fullerenes have potential for biological application. C₆₀ molecule has a significant reduction potential and is able to scavenge free radicals, its surface could be easily modified by substituent, small size and hydrophobicity allows it to interact with biological molecules and to be inserted in cell membrane. Photoexcited C₆₀ fullerenes is a highly efficient sensitizer, potentially useful for photodynamic therapy of tumors, but the kind of reactive oxygen species produced in the medium as well as the mechanisms of damaging effect on structural components of the normal and transformed cells are still not clear. The aim of the study was to estimate the indexes of metabolic state of the normal (rat thymocytes) and oncotransformed (Erlach ascites carcinoma and leukemia L1210) cells under the action of photoexcited C₆₀ fullerenes. Samples of C₆₀ fullerenes colloidal solution (2·10⁻⁴M) were prepared as described in [1].



Biological application of C₆₀ is strongly limited by its poor solubility and aggregation in aqueous medium. To provide a proportional distribution of C₆₀ in the contact zone, to increase the contact area, prevent aggregation and optimize the specific interaction with the cell we performed C₆₀ immobilization on the spherical nanoparticles of aminopropylsilica. The surface of C₆₀ fullerene as the constituent of the composite was minimally modified (because significant modification – photoexcitation) – it was covalently sewed to aminogroups on the surface of the particle. Two types of nanoparticles were synthesized – C₆₀-aminopropylsilica (composite 1, Figure) and C₆₀ – anthracenylaminopropylsilica with anthracene antenna to increase photosensitization of C₆₀ in the visible region. UV/vis irradiation of C₆₀-containing composites in aqueous media was done by Hg-lamp in diapason 320 – 580 nm. After introduction of photoexcited composite into cell suspension the C₆₀ concentration was 10⁻⁵M. Cells were incubated up to 24 h. Generation of reactive oxygen species in cell suspension was determined by EPR spectroscopy.

Photodynamic damage of oncotransformed cells by photoexcited C₆₀ – composites was confirmed both at mitochondrial and nuclear level. The decrease of cell viability, enhanced content of terminal products of free-radical peroxidation, inhibition of mitochondrial respiratory activity, estimated by MTT test and intensification of DNA fragmentation was observed, more pronounced in suspension of Erlach ascites carcinoma cells than in L1210 cells. No effects of photoexcited C₆₀ – composites were detected in thymocytes suspension.

It is supposed that the different effects of photoexcited composites are connected with distinctions in membrane permeability and structure of the surface of the normal and oncotransformed cells. Data obtained testify to perspective utility of C₆₀ – composites for optimization of photodynamic therapy methods.

Reference

1. Golub A, Matyshevska O, Prylutska S, et al. Fullerenes immobilized at silica surface: topology, structure and bioactivity. *J Mol Liq* 2003; **105**: 141-7.

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