Nanocomposites and nanomaterials

Investigation of tumor cell death mechanisms under influence of hybrid multicomponent nanosystems and PDT

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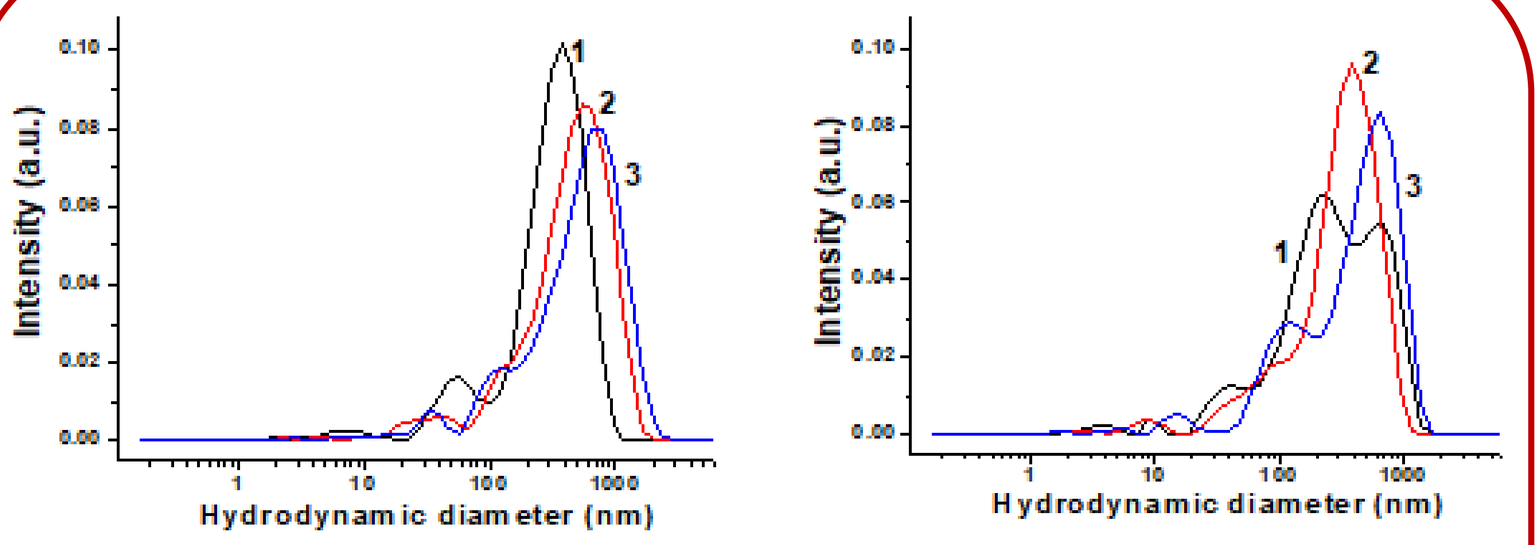
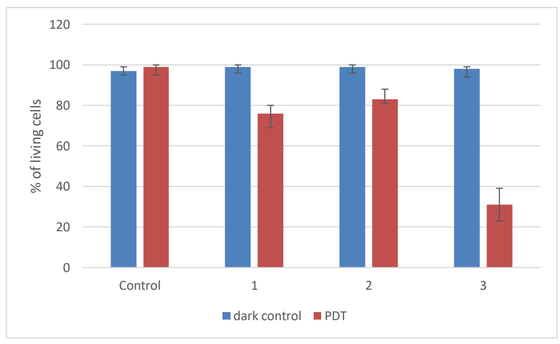
Recently, the possibility of using nanocomposites based on polymers as targeted delivery systems of photosensitizers (PS) for photodynamic antitumor therapy (PDT) has been actively investigated. Nanocomposites containing PS have several advantages over the original photosensitizing drugs, since they allow to prevent aggregation of PS molecules, which leads to a decrease in its activity. In addition, polymer-based nanocomposites can be further loaded with various drugs, which enhance the effect of the treatment. Gold nanoparticles have recently been proposed for use in PDT. In systems containing gold nanoparticles (AuNPs), it is possible to achieve an increase in the quantum yield of singlet oxygen formation.

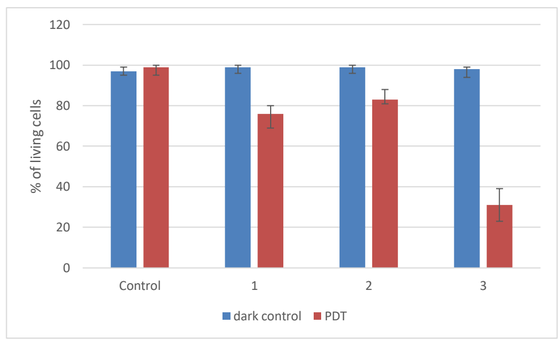
In the first phase of our study, a hybrid nanosystem containing a single branched polymer, gold nanoparticles and photosensitizer was synthesized and tested. As the polymer-nanocarrier was used star-like copolymer with the dextran core and polyacrylamide branches, and as a photosensitizer was used Chlorin e6.



The dependence of the normalized scattering intensity on the hydrodynamic diameter of the scattering objects for the Polymer/AuNPs/Ce6 (black), Polymer/AuNPs/Dox (red) and Polymer/AuNPs/Ce6/Dox (blue) nanosystems at 25 ºC (**a**) and 37 ºC (**b**).

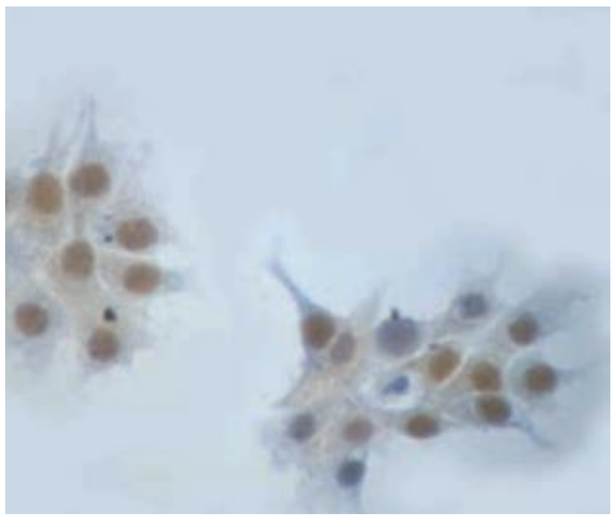


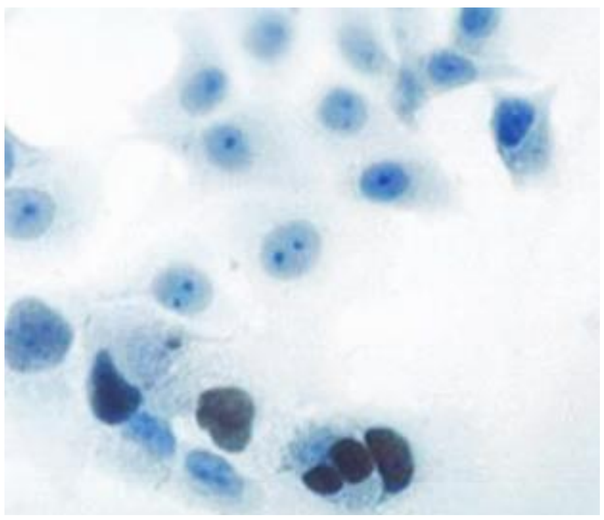
Effect of PDT on survival of MCF-7/S cells



Effect of PDT on survival of MCF-7/Dox cells

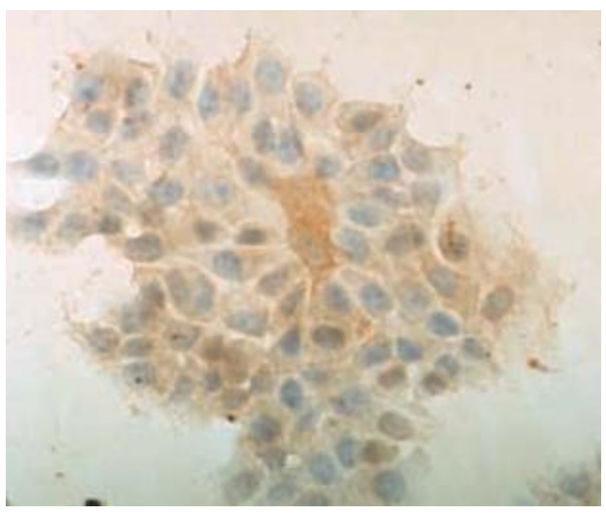
Expression of Ki-67 in MCF - 7/S cells after exposure to Nanocomposite in combination with PDT, x400

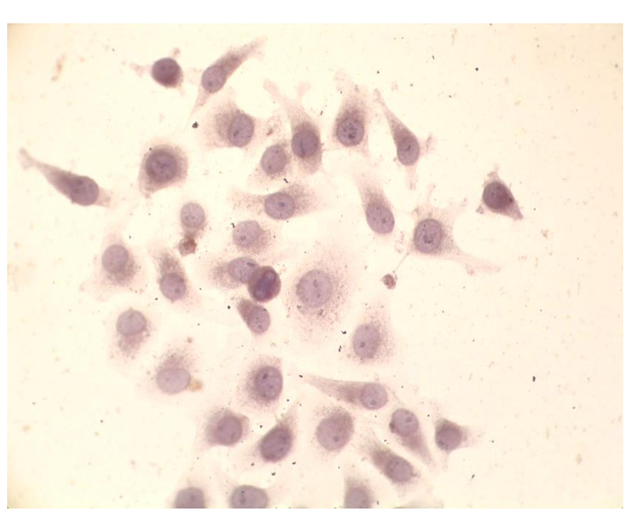




Expression of Bcl-2 in MCF - 7/Dox cells after exposure to Nanocomposite in combination with PDT, x400

Expression of Bcl-2 in MCF - 7/S cells after exposure to Nanocomposite in combination with PDT, x400





Expression of B ax in MCF - 7/Dox cells after exposure to Nanocomposite in combination with PDT, x400

The cytotoxic activity of hybrid nanocomposites was studied on the following malignant transformed cell lines: MT-4 (T-cell suspension line isolated from a patient with adult T-cell leukemia; contains the genome of human T-cell leukemia virus type 1); human breast cancer (RMZ) cell lines MCF7 (cisplatin-resistant MCF7/DDP, doxorubicin-resistant MCF7/Dox, and sensitive to these MCF7/S cytostatics); Jurkat (a T-cell suspension line isolated from a patient with T-cell leukemia).

It has been established that, under the action of nanosystems in combination with PDT cells, both suspension and monolayer cultures, perish primarily by apoptosis. The features of the cell cycle of cells after exposure to the nanocomposites in combination with PDT have been studied. An increase in the number of cells in the G0/G1 phase was established, against the background of their decrease in the S-phase.