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SCIENCE, TECHNOLOGY AND INNOVATION AT THE EPOCH OF HAPPINESS OF THE POWERFUL STATE

НАУКА, ТЕХНИКА И ИННОВАЦИОННЫЕ ТЕХНОЛОГИИ В СЧАСТЛИВОЙ ЭПОХЕ МОГУЧЕГО ГОСУДАРСТВА

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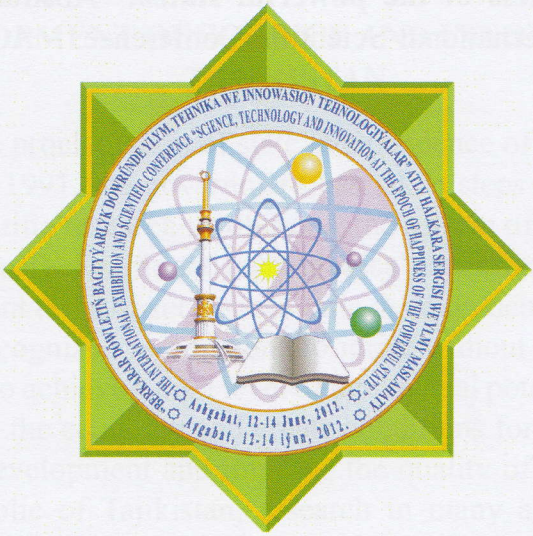

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Dekhtyar Yury, Romanova Marina, Kačanovska Anna, Skrastiņa Dace, Renhofa Regīna, Pumpēns Pauls, Patmalnieks Aloizijs
(Latvia)

SILICA NANOPARTICLES AS A CARRIER OF VIRUS-LIKE PARTICLES FOR HEPATITIS B VACCINE

Virus like particles (VLP) can be used as immune response-modulating molecular agents in vaccines. VLP are injected into blood vessels and delivered to target cells where they stimulate antibody production. Treatment efficiency is higher when concentration of VLP near the target cells increases. However, high concentrations of VLP in the human organism might result in side effects.

In order to reduce the overall concentration of VLP simultaneously increasing the local concentration near the target cells, many VLP can be attached to one nanoparticle or clusters of nanoparticles that will deliver VLP to the cells. The hepatitis B VLP were explored. Electric charge exists on the surface of the hepatitis B VLP [1], so they can be attached to nanoparticles due to electrostatic (Coulomb) interaction if the nanoparticles have an opposite charge. Thus, the nanoparticle must have ability for polarization and must be harmless to human organism. Both conditions are satisfied by SiO2 nanoparticles [2,3].

The hepatitis B viral capsids were synthesized in the Latvian Biomedical Research and Study Centre. Certified SiO2 nanoparticles were bought from the Sigma-Aldrich. Size of the nanoparticles was 10 – 20 nm.

To study adherence of the hepatitis B VLP to the SiO2 nanoparticles, optical absorbance of the solutions with VLP, SiO2 nanoparticles and VLP+SiO2 mixture was measured. The results showed that absorbance of the SiO2 and VLP+SiO2 solutions decreased after 24 hours (the wavelength 260 nm was taken as a reference) and precipitations formed at the bottom of the test-tubes. However, the absorbance of the VLP solution did not change after 24 hours and no precipitations formed.

The measured optical absorbance of the VLP+SiO2 solution was compared with the calculated theoretical absorbance in order to see if VLP attach to the SiO2 nanoparticles. According to the

spectrophotometry laws, these two values must be equal if no interaction between the particles exists. To calculate the theoretical value, the absorbance of the VLP solution at 260 nm was summed up with the absorbance of the SiO2 solution at 260 nm. Results showed significant difference between the theoretical and the experimental values. The difference was more pronounced when the time given for VLP and SiO2 interaction increased. This proved that VLP adhered to the SiO2 nanoparticles.

VLP+SiO2 adherence was also examined by transmission electron microscopy (TEM) and fluorescence microscopy (FM). Both TEM and FM showed the attachment of VLP to the SiO2 nanoparticles. In case of FM, the VLP solution without the nanoparticles had homogeneous fluorescence. When the SiO2 nanoparticles were added, VLP attached to them and fluorescence existed only in regions where VLP adhered to the SiO2 nanoparticles.

A preliminary immunological experiment was performed to study the humoral response of Balb/c mice after the immunization with the VLP+SiO2 mixture. The immunization was made on days 0, 14 and 28. Mice from the control group were immunized with VLP only. Two weeks after the 3rd immunization (on the day 42) all animals were bled and anti-HBc antibody response was examined.

The results of the preliminary immunological experiment showed that the amount of antibodies produced in Balb/c mice blood depended directly on concentration of the SiO2 nanoparticles in the VLP+SiO2 mixture. Dose of VLP in the mixtures was kept constant and was equal to 25 μg. However, concentration of SiO2 varied thus producing different amount of the VLP+SiO2 complexes. VLP without SiO2 induced lower antibody response than the VLP+SiO2 complexes.