Study Shows Silver Nanoparticles Attach to HIV-1 virus

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In the first-ever study of metal nanoparticles' interaction with HIV-1, silver nanoparticles of sizes 1-10nm attached to HIV-1 and prevented the virus from bonding to host cells. The study, published in the *Journal of Nanotechnology*, was a joint project between the University of Texas, Austin and Mexico Univeristy, Nuevo Leon.

"Our article opens an important avenue for research," said Miguel Jose Yacaman, from University of Texas, Department of Engineering and one of the study's authors.

In this study, scientists mixed silver nanoparticles with three different capping agents: foamy carbon, poly (PVP), and bovine serum albumin (BSA)."Not using a capping agent could result in the synthesis of big crystals instead of nanocrystals," explained Yacaman.

Transmission electron microscopy (TEM) showed the silver nanoparticles in the foamy carbon matrix were joined together, but an ultrasonic bath in deionized water released a significant number of nanoparticles. These nanoparticles were of size 16.19 (+-8.69)nm and had the greatest variety of shapes, such as icosahedral, decahedral, and elongated.

"Because of the synthesis procedure, the foamy carbon-coated naoparticles are more likely to have broad shape distribution," said Yacaman. Scientists used the electron beam to release the remainder of the nanoparticles from the joined bundle.

For the PVP-coated silver nanoparticles, scientists used glycerine as a dissolving agent. These particles were of size 6.53 (+-2.41). In the third preparation, scientists used serum albumin, the most common protein in blood plasma. The sulfur, oxygen, and nitrogen chemicals in BSA stabilized the nanoparticles, which were in the range of 3.12 (+-2.00) nm.

Scientists studied the absorption spectra of the different preparations to pinpoint their shapes. "Spherical nanoparticles absorbed in the blue region of the spectrum, for example," Yacaman said.

Also, the UV-Visible spectra graphs helped the group determine nanoparticle sizes. "The surface plasmon resonance peak wavelength increased with size," explained Yacaman.

Scientists tested, in vitro, each of three silver nanoparticle-preparations in HIV-1 cells. Yacaman and his colleagues incubated the samples at 37 C. After three hours and 24 hours, respectively, 0% of the cells were living.

The results showed that a silver nanoparticle concentration greater than 25 ug/mL worked more effectively at inhibiting HIV-1 cells. Plus, the foamy carbon was a slightly-better capping agent because of its free surface area. Size also played a role since none of the attached nanoparticles were greater than 10nm.

Scientists think the nanoparticles bonded through the gp120 glycoprotein knobs on HIV-1, using the sulfur residues on the knobs. The spacing between the knobs of ~22nm matched the center-to-center nanoparticle spacing.

Although this study shows silver nanoparticles may treat HIV-1, scientists need to research this relationship further. "We lack information regarding the long-term effects of metal nanoparticles," cautioned Yacaman. Scientists are forming a preventive cream for HIV-1, which they will test on humans.

Scientists are also studying other uses for silver nanoparticles. "We're testing against other viruses and the 'super bug (Methicillin resistant staphylococcus aureus).' Our preliminary results indicate that silver nanoparticles can effectively attack other micro-organisms," Yacaman said.

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