

Cytotoxicity of Saccharides Coated Silver Nanoparticles: health and environment risks

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Abstract

Hazard and risks of engineered metal nanoparticles (NPs) for the environment and the human health have been debated in recent years [1]. Silver nanoparticles were synthesized through a green method by using saccharides as reducing and capping agent. UV–Visible absorption and transmission electron microscopy (TEM) were used to certify the quality of the silver nanoparticles obtained (AgNPs).

We investigated the toxic effects of two concentrations of AgNPs on human epitheloid cervix carcinoma cells (HeLa), human lymphocytes in terms of cell viability (MTT) and silver absorption (GF-AAS) as well as on the development of sea urchin *Paracentrotus lividus* (*P. lividus*).

Silver nanoparticles were synthesized through a green method by using different saccharides as reducing and capping agent. UV–Visible absorption and transmission electron microscopy (TEM) were used to certify the quality of the silver nanoparticles obtained (AgNPs).

AgNPs induce a time and dose – dependent toxicity on HeLa cells; internalization kinetics depends on the NPs concentration and incubation time too. Infact AgNPs enter in HeLa cells when these are still viable, with a maximum absorption after 2hr of incubation; then the NPs determine a decrease of the cellular viability and it was observed a gradual release of silver into the culture medium [2].

AgNPs were absorbed/taken up by lymphocytes and cytotoxicity and morphology changes were amount and time-dependent. By incubating cells with the highest NPs amount only 10% viable lymphocytes were found at the end of experimental time. Parallel to cytotoxicity morphological modifications and ROS generation were induced, thus supporting the increasing cell deaths. Our findings suggest that AgNPs -induced cytotoxicity depends on NPs amount and provide evidence of AgNPs adsorption/entering by lymphocytes; however, the mechanisms of interaction/internalization needs to be further investigated [3].

The role of the NPs saccharides capping for the embryotoxic potential of AgNPs was explored in sea urchin *Paracentrotus lividus* (*P. lividus*) gametes and embryos. *P.lividus* gametes and embryos were incubated with increasing number of silver nanoparticles (AgNPs) and fertilization capability and development up to the pluteus stage was investigated. AgNPs delayed embryo development, caused malformations leading to embryos death in a concentration dependent way [4].

References

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Figures

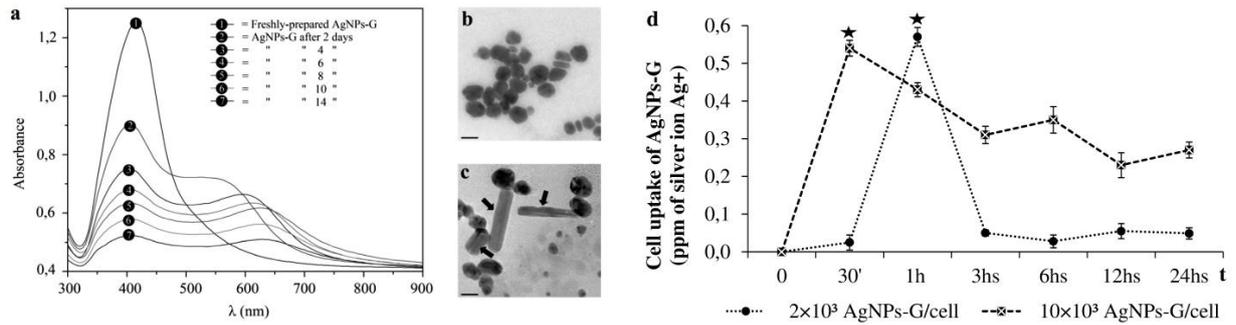


Figure 1. UV-Vis Absorbance, Shape and Cell Absorption/Uptake of AgNPs-G. (a) UV-Vis absorbance spectra of AgNPs-G in 23 mM β -D-Glucose water solutions obtained from freshly prepared solution and throughout 14 days. TEM micrographs of freshly-prepared (b) or 4 days old AgNPs-G (c), when nanorods are present (black arrows). Bar = 30 nm. (d) Cell absorption/uptake of AgNPs-G throughout 24hs. The absorption/uptake of AgNPs-G was indirectly calculated as ppm of Ag⁺ absorbed/internalized by the cells from the culture medium. Each value represents the mean \pm SE of six independent experiments, each done in duplicate. Stars show values significantly different from all the other values of the same treatment. SEs never exceeded 0.05.

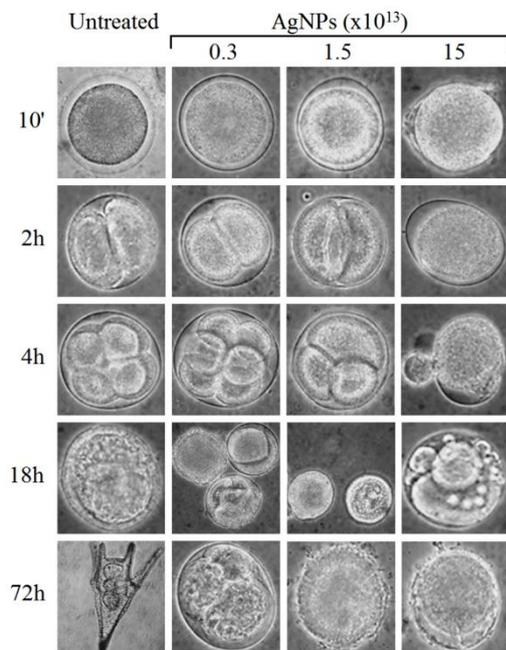


Figure 2 Fertilization and development stages of sea urchin *P. lividus* incubated with different amounts of AgNPs. In the panel are shown from left to right side the: control and treated embryos with 0.3, 1.5 and 15×10^{13} AgNPs in 500 cm³ of MFSW. The development stages observed are: lifting of the FM that happens 10 min after fertilization, two blastomeres at 2 h, four blastomeres at 4 h, ciliated blastula at 18 h and pluteus larva at 72 h of culture.

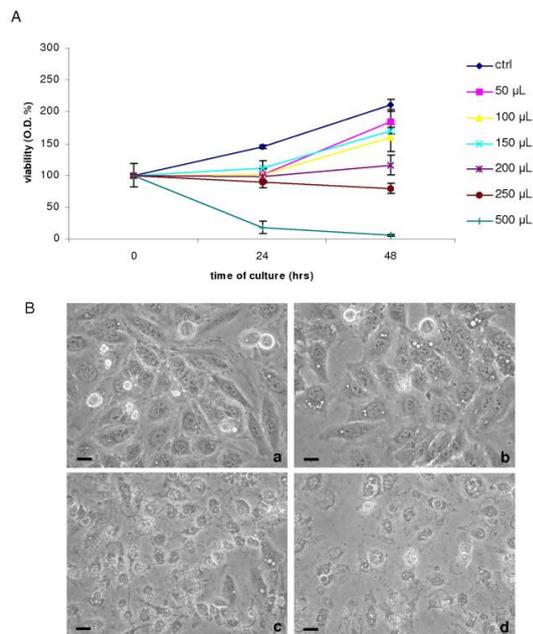


Figure 3. A: MTT assay performed in HeLa cells after incubation with AgNP (50, 100, 150, 200, 250 and 500 μ l/3 ml of culture medium) for 24 and 48 hrs. Values (absorbance reported as percentage respect to the untreated cells at 0 hr of incubation, considered as 100%) are the average \pm SD of three independent experiments. B: Light inverted microscope micrographs of HeLa cells incubated with AgNP after 24 and 48 hrs. a) 24 and b) 48 hrs of culture with 50 μ l of AgNP; c) 24 and d) 48 hrs of culture with 500 μ l of AgNP; Bars = 10 μ m