IMPACT OF SIZE AND SURFACE PROPERTIES ON GENOTOXICITY OF NANOSILVER

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Abstract

We investigated whether the toxicity of nanosilver (AgENMs) is size-dependent, by comparing effects of particles with the same chemical composition, charge and coating but with different, sizes (50, 80, 200nm). Additionally, we studied the effect of charge and surface composition on toxicity, using AgENMs of the same size, shape and specific surface area, but with different charges and surface compositions. AgENM uptake and subcellular localisation, dissolution and aggregation in protein-rich media, were also investigated.

Uptake and localisation, cell proliferation, cytotoxic effects, DNA damage (strand breaks and oxidised DNA lesions were assessed in A549 and TK6 cells, and the mutagenic potential of AgENMs in V79-4 cells. Physico-chemical characterization of the ENMs was performed in water/solvents and in biological media as a prerequisite to assessment of their impacts on cells.

All AgENMs were cytotoxic and genotoxic. However, 200nm AgENM was the most mutagenic. Regarding surface properties, positively charged AgENMs had greater impact on cytotoxicity/genotoxicity than did Ag ENMs with neutral or negative charge, likely to be related to their presence in the nucleus, implying a direct interaction with DNA.

Summarising, we demonstrated that AgENMs are potentially genotoxic and mutagenic and can induce different DNA lesions directly by contact with chromatin or DNA, or indirectly by reactive oxygen species, as indicated by DNA oxidation.

We suggest that expression of concentrations of ENMs as number of ENMs or surface area of ENMs (per cm2) is the most meaningful way to compare the toxicity of nanomaterials.

Keywords: Nanomaterial genotoxicity, nanosilver

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