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Genotoxicity of metal based engineered nanoparticles in aquatic organisms: A review

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ABSTRACT:

Engineered nanoparticles (ENPs) are an emerging class of environmental contaminants, but are generally found in very low concentrations and are therefore likely to exert sub-lethal effects on aquatic organisms. In this review, we: (i) highlight key mechanisms of metal-based ENP-induced genotoxicity, (ii) identify key nanoparticle and environmental factors which influence the observed genotoxic effects, and (iii) highlight the challenges involved in interpreting reported data and provide recommendations on how these challenges might be addressed. We review the application of eight different genotoxicity assays, where the Comet Assay is generally preferred due to its capacity to detect low levels of DNA damage. Most ENPs have been shown to cause genotoxic responses; e.g., DNA or/and chromosomal fragmentation, or DNA strand breakage, but at unrealistic high concentrations. The genotoxicity of the ENPs was dependent on the inherent physico-chemical properties (e.g. size, coating, surface chemistry, e.tc.), and the presence of co-pollutants. To enhance the value of published genotoxicity data, the role of environmental processes; e.g., dissolution, aggregation and agglomeration, and adsorption of ENPs when released in aquatic systems, should be included, and assay protocols must be standardized. Such data could be used to model ENP genotoxicity processes in open environmental systems.