Nanotoxicity of metal nanoparticles on aquatic organisms: some facts and gaps

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Abstract

The production and use of engineered nanomaterials (ENMs) have increased exponentially during the last years, with an estimated global market of about $ 1 billion [1] thus by 2015. The application of new materials and technologies in industrial processes and consumer products, and their use in diverse disciplines will trigger a substantial advance in science and technologies. Nevertheless, it should be taken into account that these products may have impacts on human and environmental health.

Among the different ENMs, metal nanoparticles (MNPs) are of mayor interest due to their properties and widespread use (e.g., AgNPs as antibacterial agent; ZnONPs paints, cosmetics, fertilizers, TiO_2NPs in sunscreens as blocking agent of UV irradiation). As a consequence of their use, MNPs can reach freshwater, estuarine and coastal ecosystems where they can interact with aquatic organisms eventually leading to the development of adverse effects. The fate and effects of MNPs in the environment will depend on the amount of released nanoparticles and their physicochemical characteristics (size, surface/volume ratio, shape, chemical composition, etc.) which can be altered by environmental parameters [2]. The lack of specific analytical methods for detection and quantification of MNPs in the environment complicate the design of ecotoxicity tests with ecological relevance, although an agreement of the environmental concentrations can be reached [3].

The effect of MNPs on freshwater organisms has been reviewed by several authors [4-9]. Nevertheless, the knowledge about the toxic effects on marine species is limited. Recently, Baker et al. (2014) [10] have published a review where they point out that “clear and major gaps of the effects of metal and metal oxide nanoparticles on marine organisms is being gathered slowly”. With the aim to contribute to fill the gaps in available information on the effects of MNPs in marine organisms, some results of our group on gold, silver and gold-silver nanoparticle toxicity with marine phytoplankton, which conforms the base of the marine trophic nets, are presented. On the other hand, we chose a mollusk (clam, *Ruditapes philippinarum*) as model organism for examining the mechanisms involved in gold-citrate nanoparticle exposure at environmentally relevant concentrations. Information on the endpoint reproduction in the freshwater shrimp (*Athyaephyra desmarestii*) will be also showed.

Finally, new approaches should be discussed to improve the knowledge about MNPs effects on marine species and for testing nanomaterials according to OECD recommendations [11].

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