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Impact of ZnO Nanoparticles on the Biodiversity of Aquatic Flora and Fauna: A Brief Note

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Introduction

Researches on nanomaterials are of keen interests to the researchers due to their unique properties leading to versatile applications not only in nanoelectronics, displays, sensors, spintronic devices but also in in the field of medical science [1,2]. Nanoparticles, due to their tiny sizes, have very high surface to volume ratio. Thus the nanoparticles are very sensitive to surface related phenomenon like gas sensing, adsorption, and surface charge transfer phenomena [3,4]. Gold, silver, zinc oxide (ZnO) and titanium oxide nanoparticles are very commonly used in several cosmetics [5]. When these cosmetics are washed out, these nanoparticles are directly goes to the aquatic environment. Thus these nanoparticles comes in direct contact of the living cells of several bacteria, microbes and small creatures of the aquatic medium and also to the several flora. As these nanoparticles are very surface reactive, they sometimes destroys the bacteria, microbes and several flora of the aquatic environment. Thus the biodiversity of the aquatic environment get unbalanced. Here in this note we shall describe in brief the impact of ZnO nanoparticles on the biodiversity of aquatic floral and faunal biodiversity.

Source and Release of Zno Nanoparticles in the Aquatic Environment

ZnO is a very well-known direct band gap semiconductor being investigated over the last two decades due to its unique optoelectronic properties. It has a direct band gap of 3.37eV. This leads ZnO a potential material for UV emission and absorption. Due to several defect states and sometimes due to doping of foreign element, ZnO exhibit photoluminescence in the visible region. Thus it can also absorb visible light. Thus UV and visible absorption properties of ZnO nanoparticles make it a potential material to be used in several sunscreens and cosmetics [6]. Besides ZnO nanoparticles exhibit excellent antibacterial activity against several bacteria, microbes and fungi like *Neisseria gonorrohea, Aspergillus niger, Streptococcus mutans, S. aureus, P. mirabilis, C. freundii, Vibrio cholerae, S. marcescens, E. coli, R. stolonifer* and *A. nidulans* [7]. Not only that ZnO nanoparticles dispersed in water get consumed by several fishes and fauna during their respiration and food absorption from water. ZnO then comes directly into contact of the lungs cells and stomach of those fauna and thereby changes the cell behaviour. This affect greatly the normal cellular behaviour of those fauna.

Mechanism of ZnO Nanoparticles and Living Cell Interactions and Its Effect on Aquatic Biodiversity

In living cell the cytoplasm is enclosed by cell membrane and cell wall. The cell wall may be composed of mono layer or multilayer of peptidoglycan polymer and the width of cell wall is ~30-100nm. Thus ZnO nanoparticles of size ~50nm can directly penetrate the cell wall and membrane and enters into the cytoplasm of the cell. In cytoplasm there are various ions, salts, nucleic acids and carbohydrates in the fluid. Thus the fluid is ionic in nature and maintain the electrical conductivity of the cell. When nanoparticles enters into the cytoplasm, due to their high surface and charge transfer probability, changes the electrical conductivity of the cell. Thus the usual cell mechanism is disrupted in presence of the nanoparticles in the cytoplasm. This leads to the destruction of the cell and there by the microbes, bacteria and other small living organism of the aquatic environment. Thus the biodiversity of the aquatic environment gets very much affected.

Conclusion

The nanomaterials are very useful in several application. But still there are some adverse effect of the nanoparticles on the environment. Although it has not yet been proved that ZnO nanoparticles affects human life but it is proved fact that it destroys bacterial cells. Chemically synthesized ZnO nanoparticles are also found to be toxic. Thus the direct release in the environment must be restricted. Researchers are developing green synthesis method to synthesize nanoparticles to reduce their toxicity. But still it is a challenge to the researchers.

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