Induction of Morphological Alterations and Intracellular Damages in Cyanobacterium *Spirulina platensis* by Zinc Oxide Nanoparticles

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INTERNATIONAL CONFERENCE ON RECENT TRENDS IN HUMANITIES AND SCIENCE 2018, 'ICRTHS-2018'.
UNIVERSITI TUNKU ABDUL RAHMAN, BANDAR BARAT, 31900 KAMPAR, PERAK, MALAYSIA.
26TH OCTOBER 2018.
American J of Bio-pharm Biochem and Life Sci 2014 December, Vol. 6: OP14

ABSTRACT

The rapid expansion of nanotechnology and its application in consumer products in recent days alerts the risk of releasing the nanoparticles (NPs) residues into the water bodies. The presence of NPs in the aquatic sediments enables the adsorption of NPs on the aquatic organisms and thus may bring the surface and intracellular damages to the aquatic biota which can cause death of the organisms. Due to the extensive usage of zinc oxide nanoparticle (ZnO NP) in the cosmetic products and the subsequent release of its residues into the aquatic environment, the present study was aimed to investigate the surface and the intracellular damages of ZnO NPs on the cyanobacterium *Spirulina platensis* which forms the base for food web of aquatic biota. The interaction of ZnO NPs on the algal cells was demonstrated by the FTIR spectrum obtained from ZnO NPs treated cells. Our results demonstrated the possible participation of hydroxyl, carboxy and amino groups of polysaccharides and proteins of algal cell wall in binding of ZnO NPs on the cells. The SEM EDX spectrum of ZnO NPs interacted cells evidenced aggregation of algal cells due to the surface accumulation of ZnO NPs and also confirmed the presence of Zn in algal biomass treated with ZnO NPs. The light microscopic and SEM images of ZnO NPs treated cells displayed encapsulation of algal cells with NP agglomerates, cell membrane damage, fragmentation of trichrome and aggregation of cells with distorted morphology. TEM micrographs of ZnO NPs treated algal cells showed destruction of intracellular organelles, most importantly the photosynthetic system through remarkable reduction and degradation of thylakoid lamellae and photosynthetic pigment phycobilisomes. Overall, the results of the study suggest that the presence of NP residues in the water bodies can harm the aquatic biota through surface binding and accumulation. The findings of the study might be useful to develop a biosensor for detecting the presence of NPs in the aquatic bodies using *S. platensis* as a bioindicator.