Effect of citrate-functionalized TiO_2 nanoparticle size on photo-dependent toxicity in the zebrafish embryo

M.-S. Kim[1], K. M. Louis[2], J. A. Pedersen[3,4], R. J. Hamers[2], R. E. Peterson[1,3] and W. Heideman[1,3]

[1]Pharmaceutical Science Division, School of Pharmacy, [2]Department of Chemistry, [3]Molecular Environmental Toxicology Center, [4]Department of Soil Science, University of Wisconsin, Madison, USA

ABSTRACT

Titanium dioxide nanoparticles (TiO_2NPs) are used in a wide range of applications, and concerns have been raised about the potential hazard of these nanoparticles to humans and the environment. To elucidate the size influence of size on TiO_2NP toxicity, we investigated the effect of primary particle size (d_p) of citrate-functionalized anatase TiO_2NPs on photo-dependent toxicity in the zebrafish embryo. Three differently sized citrate-functionalized TiO_2NPs (d_p = 6, 12.4 and 15 nm) were used, and embryos were exposed (4-120 hpf) to graded concentrations of these TiO_2NPs under either simulated sunlight illumination or in the dark. Under illumination, the toxicity of citrate-functionalized TiO_2NPs increased significantly and an inverse relationship between d_p and toxicity was observed. Smaller particles generated higher levels of reactive oxygen species (ROS) under both *in vitro* and *in vivo*. Increased ROS production resulting in more oxidative stress and oxidative DNA damage may be responsible for the higher toxic potency of smaller citrate-functionalized TiO_2NPs. These results highlight the need to consider nanoparticle size in assessing the hazard(s) posed by TiO_2NPs.