

Zebrafish as an *in vivo* Vertebrate Model for Nano EHS Studies

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Editorial

Manufactured nanomaterials have at least one dimension between 1 nm and 100 nm. Nanomaterials possess unique physicochemical properties such as quantum effects, increased surface area and higher surface curvature as well as unique electric, thermal, mechanical, and imaging properties [1]. The toxicity study of nanomaterials is getting great attention as the increasing exposure of these materials on human and ecological environment [2]. With the rapid expansion of nanotechnology, there is a growing application of nanomaterials in various fields, such as industry, biotechnology and medicines [3]. Environmental Health and Safety (EHS) is one of the challenges in the field of nanotechnology that focusing on the consideration of the hazardous properties of engineered nanomaterials to the environment and human beings. Currently, zebrafish has introduced as an *in vivo* vertebrate model for nano EHS studies. This is due to some of their characteristics such as lower husbandry cost, optical transparency, and high degree of genomic homology to humans. Moreover this model organism has been reported for assessing of various nanomaterials including metal or metal oxide nanoparticles and polymers [2]. Nanomaterials end up in the environment, that is, in water, sediments and soil [4]. Nanoparticles can be absorbed through the skin, lungs and digestive system [5]. Upon exposure to nanoparticles, Reactive Oxygen Species (ROS) generation induces oxidative DNA damage, protein denaturation and lipid peroxidation demonstrating the mutagenic and carcinogenic properties of nanoparticles [6].

There are some studies that evaluate toxic effects of different nanoparticles using zebrafish model organism. Duan et al. [2] evaluated toxic effects of silica nanoparticles on zebrafish embryos and larvae. The results showed that as exposure dosage increasing, the hatching rate of zebrafish embryos was decreased while the mortality and cell death were increased. Moreover exposure to silica nanoparticles caused various embryonic malformations [2]. Zhu et al. [1] studied toxic effects of iron oxide nanoparticles in zebrafish early life stages. The results showed that iron oxide nanoparticles instigated developmental toxicity in zebrafish embryos, causing hatching delay, mortality and malformation [1]. In other study, Hu et al. [3] evaluated

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toxicity of biodegradable chitosan nanoparticles using a zebrafish embryo model. Exposure to chitosan nanoparticles resulted in a decreased hatching rate and increased mortality. Moreover some malformations were seen in zebrafish embryos following exposure to these nanoparticles [3]. Kovrižnych et al. [7] tested acute toxicity of 31 different nanoparticles in adulthood and early life stages of zebrafish. Their results showed that calcium oxide, copper, copper in the form of oxide and $\text{CuZnFe}_4\text{O}_4$, magnesium oxide, and nickel cause cumulative mortality and two kinds of nanoparticles- copper and silver were toxic [7]. Molecular mechanisms of toxicity of silver nanoparticles in zebrafish embryos were evaluated by Aerle et al. [8]. They confirmed that the toxicity of silver nanoparticles is principally associated with bioavailable silver ions in exposed zebrafish embryos. Titanium dioxide nanoparticles effect on zebrafish embryos and developing retina were studied by Wang et al. [9]. The results showed that short-term exposure to TiO_2 nanoparticles at a low dose not lead to delayed embryonic development or retinal neurotoxicity. Toxic effects of magnesium oxide nanoparticles on early developmental and larval stages of zebrafish were evaluated by Ghobadian et al. [10]. They showed that MgO nanoparticles induces cellular apoptosis and intracellular reactive oxygen species and the hatching rate and survival of embryos decreased in a dose dependent manner. Moreover, various types of malformations were observed in zebrafish larvae following embryonic exposure to MgO nanoparticles [10]. Overallly it can be concluded that today zebrafish has become a promising model in nano EHS studies and great advances in this field will be achieved.

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