中文題目：以顯微影像分析技術測量奈米銀與奈米銅對斑馬魚心血管功能之影響

英文題目：Establishing an Image-Based Functional Analysis to Investigate the Effects of Silver and Copper Nanoparticles on Cardiovascular System of Zebrafish Embryos

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Background:

nanoparticles have been widely used in modern industry due to its exactly different properties compared with the larger particle form of the same composition. Among all the nanoparticles, silver-nanoparticle (AgNP) and copper-nanoparticle (CuNP) are two of the most common materials in nanotechnology. The adverse effects caused by the intake of AgNP and CuNP have been confirmed in different physiology indicators. However, few reports have revealed the toxicity of AgNP and CuNP on the cardiovascular system. In this study, we use zebrafish as an animal model to evaluate the toxicity of metal NP on the development of embryos, including survival rate, hatching, and body length. We attempt to acquire a better understanding of the toxic effect of NPs widely used in our daily life.

Method:

AgNP dispersion with 10 nm particle size was stabilized with sodium citrate in aqueous buffer, while CuNP with 25 nm particle size was in powder form. NPs were dissolved in normal water. We use zebrafish as an animal model. Embryos were exposed in different medium from 4 hpf to 96 hpf. Survival rate were recorded every day, while the hatching of the embryos was recorded at 72 hpf and 96 hpf. Other analyses such as cardiovascular function and body length were only recorded at 96 hpf as well. Following drug exposure, the individual larva was anesthetized with Tricaine methanesulfonate. We applied the videomicroscopic method, which featured high-frame-rate recording with fine resolution, to assess the cardiac and vascular function on living embryos.

Results:

This study found that CuNP exposure led to a severe interference in embryos hatching. And 0.1 ppm or higher concentration of CuNP exposure causes reduced efficiency in the circulation of zebrafish embryos in early development. These effects led to the reduced cardiac function in blood transportation On the other hand, AgNP doesn’t pose an adverse effect on the hatching of the embryos. But AgNP would cause severe decrease in size, contractility of the ventricle. As a result, both AgNP and CuNP would cause a decline in the efficiency of the circulation.

Conclusion:

This is the first study to discuss detailed cardiovascular toxicity of AgNP and CuNP on zebrafish embryos. While CuNP majorly inhibits the growth and contractility of the ventricle, AgNP would cause severe decrease in size, contractility and heart rate of the ventricle. To sum up, we suggest that AgNP and CuNP pose a serious threat to the aquatic organism.