Effects of waterborne exposure of different copper nanoparticle levels on oxidative stress in Siberian sturgeon (*Acipenser baerii*) juvenile

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Abstract
Nanoparticles (NPs) have important characteristics that include small size, wide surface, and specific optical properties and surface coatings that increase their activity when enters the body, which results in more toxicity of NPs. NPs absorption pathways in fish include absorption through the gill and intestinal epithelium as a result of exposure to diet and drink or through the skin. This study aimed to investigate the effect of different levels of copper nanoparticles (Cu-NPs) on oxidative stress in the liver of Siberian sturgeon (*Acipenser baerii*). 240 Siberian sturgeon juvenile (with initial weight of 29.2 ± 3.1 g and initial length of 21.8 ± 1.4 cm) were randomly distributed in 12 fiberglass tanks at 4 different Cu-NPs treatments with 3 replicates. The Cu-NPs concentration (0, 50, 100 and 200 µg/l) and time (0, 7, 14, 21 and 28 days) were considered. The experimental period was 28 days, 14 days exposure to copper nanoparticles and 14 days as recovery time. At days 0, 7, 14, 21, and 28 six fish tissues from each group (two fish of each replicate) were sampled. The activity of antioxidant enzymes from

the beginning of the experiment to 14 days were increased and in the recovery period from the day 14 to 28, the activity of them were decreased but was higher than the control. There were significant difference in SOD and MDA but there were no significant differences in CAT and GPx enzymes. The current findings indicate that Cu-NPs had chronic physiological effects on the Siberian sturgeon even though the recovery period, complications of these nanoparticles are not completely resolved.

Keywords: Nanoparticle, Copper, Siberian sturgeon, SOD, CAT, MDA, GPx.