TOXICITY ASSESSMENT OF NOVEL NANOPARTICLES ENGINEERED TO DISPERSE CRUDE OIL MONITORED USING A GENE EXPRESSION BIOMARKER IN FATHEAD MINNOW JUVENILES

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Uncontrolled oil releases during extraction or shipping can impact the environment due to the toxicity of its organic constituents. Dispersants have been a tool in remediating oil spills, particularly in large bodies of water, because of their ability to break up concentrated oil into dispersed microdroplets, which can be successfully metabolized by microbes. However, traditional chemical dispersants depend on their critical micellar concentration to disperse the oil, which quickly is missed by infinite dilution. In addition, traditional dispersants enhance ecotoxicity. A novel nanoparticle-based unimolecular micelle, based on silica with amphiphilic branches, is able to disperse oil without the need of achieving critical micellar concentration. In this study, we exposed fathead minnow embryos and juveniles to various engineered NPs, differing in their amphiphilic branch characteristics. NPs were re-suspended (1 mg/mL) in Hanks solution at 20% strength and then added to the water-accommodated fraction (WAF) of the oil. The duration of the exposure was 96h with 50% water changes every day. Endpoints measured were mortality and gene expression of cyp1a as a biomarker of PAH bioavailability. There was no mortality observed in either life stage, meaning that NPs were not acutely toxic. Cyp1a gene expression evaluation was only performed using juveniles. Results indicate that WAF elicited the expression of cyp1a as expected; on the other hand, NPs lowered the expression. In conclusion, NPs were effective in capturing oil components making them less bioavailable to fathead minnow juveniles as measured indirectly by gene expression.

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