Assessing DNA Damage from Ingested Micronanoplastics

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Hundreds of millions of tons of plastic are produced annually, most of which are incinerated in waste plants and degraded in the environment into micronanoplastics (MNPs). MNPs are exposed to animals and humans primarily through ingestion. Thus, studying the health effects of MNPs has become an emerging and crucial research area. However, research on the genotoxicity of MNPs is limited. This study aims to measure the genotoxicity of different types of MNPs using an in vitro triculture small intestinal epithelial model, including Caco-2, HT29, and Raji B cells. Primary 25 and 1000 nm carboxylated polystyrene spheres (PS25C, PS1KC), and secondary incinerated polyethylene (PE-I) MNPs were dispersed in water (fasting food model, FFM) at 0.05, 0.25, and 1.0 mg/mL. To emulate in vivo digestive processes, the suspensions went through oral, gastric, and small intestinal phases of digesta. The cell model was then exposed to MNP-containing small intestinal digesta for 24 and 48 hours. A high-throughput 96-well CometChip platform assessed DNA damage by measuring the average percentage of DNA in the comet tails. Our results showed that 24 and 48-hour MNP exposures induced dose-dependent increases in DNA damage, with statistically significant increases in the 48-hour exposures of 0.25 and 1.0 mg/mL PS 25C compared to the FFM control group ($p < 0.001$). These findings suggest that ingestion exposure to PS 25C may have caused genotoxicity to the triculture small intestinal model and emphasizes the need for further research to evaluate the genotoxicity of MNPs in vivo. Supported by NIH R25ES020721 and the School of Graduate Studies.