Global Microplastic Pollution-Year 5: A Novel Multi-Organism & Computational Approach for Investigating Microplastics' Size and Concentration-Dependent Effects for Translational Human Biomarker Discovery; and Deployment of Plant-Based, Economical, and Scalable Microplastic Remediation Systems

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Global Microplastic Pollution, an “Environmental Ticking Time Bomb”, is a significant and ongoing threat to the environment, world's water-quality, and human-health. Humans now ingest >5 grams of plastic every week, with studies showing that microplastics(MPs) cause oxidative stress, neurotoxicity, gut microbiota and endocrine disruption, cancer, obesity, and diabetes in humans. This study utilizes a Novel Multi-Organism and Computational Approach to quantify the size/concentration-dependent effects of Polystyrene MPs on a wet lab zebrafish embryo model and computational AI mouse-model for identifying translational effects to humans and develop targeted interventions. Zebrafish embryos were exposed to polystyrene/polyethylene microplastics at low/high environmentally relevant concentrations. Toxicological effects were assessed via embryotoxicity assays, emphasizing gene expression(qPCR). A Novel Deep-Learning AI-model was developed utilizing public libraries and EPA data to simulate toxicology studies on mice to translate to humans in a computational space. Parameters include microplastic concentrations and their associated organ effects, yielding a 95% prediction accuracy. A web-user interface was created to expand accessibility and data to improve AI model performance. Microplastic pollution permeates all exposure pathways, with water being the most prevalent. Hence, a potable water-filtration system was developed and validated utilizing Moringa oleifera seed powder as the filtration agent to extract microplastics and harmful contaminants from drinking water with a 99.9% filtration efficacy after testing via industry-standard water-quality metrics with integration of low-cost IoT technology for real-time potable water quality monitoring with user-friendly software.

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