Global Microplastic Pollution - The Emerging Health Crisis: The Ecotoxicological Effects of Microplastics on Aquatic Organisms and Translating to Humans via A.I. Machine Learning & a Novel Low-Cost Water Filtration System

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The escalating scale of “Global Plastic Pollution” is leading to the omnipresence of Microplastics (MPs), negatively impacting the environment, world's water quality, aquatic organisms, and human health in trophic transfer. Annually, >400 million tons of plastic enter landfills and oceans due to its non-biodegradable nature. Plastics depolymerize through physical/chemical processes fragmenting their long carbonaceous chains, producing microplastics, ≤5 mm. Polyethylene (PET)/polystyrene (PS) are the most commonly used plastics with >125 million tons produced annually. Studies show MPs are endocrine disruptors, carcinogens, diabetogens, obesogens, neurotoxins, etc. Stage 1 is a comprehensive novel investigation to bridge knowledge gaps in the size/concentration-dependent effects of PS and PET-MPs on zebrafish embryos as a model organism for humans. Embryos were exposed to environmentally relevant sizes 4, 10, and 15µm PS-MPs, and 100µm PET-MPs at lo%/hi% for 6 days-post-fertilization. Embryotoxicological effects were assessed via morphology, HR, VMR assays(behavior), and qPCR(gene expression). 3 AI models were developed to identify zebrafish deformity image recognition (convolutional neural network), predict molecular binding of chemicals in microplastics with zebrafish and human enzymes to analyze inhibitory effects, and identify biomarkers for diseases/cancers via gene expression levels from experimental data (B/C Deep Learning) for efficiently analyzing large datasets w/ 95% accuracy. Stage 2 is a novel remediation method(w/ 99% efficacy) for extracting MPs in water sources utilizing Moringa oleifera seed powder as a natural coagulant in a scalable, sustainable, and low-cost water purification prototype for mitigating the global water microplastic pollution crisis.