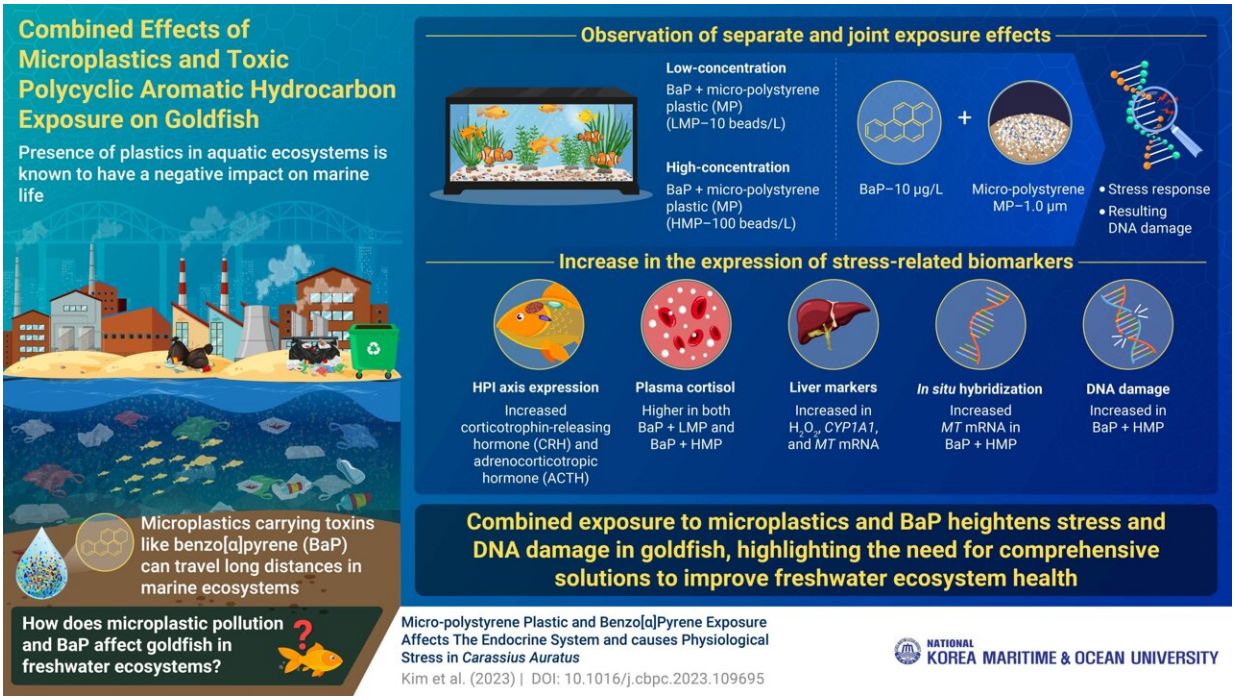
Researchers explore the impact of microplastics and toxin exposure on goldfish

January 10 2024



Microplastics can act as carriers of toxic chemicals such as benzo[a]pyrene (BaP) as they travel long distances in aquatic environments. These pollutants can have detriharmmental effects on wildlife, including disrupted stress response, bioaccumulation, and carcinogenicity. When marine life is exposed to both microplastics and toxic chemicals like BaP, these adverse effects are significantly amplified, leading to more severe impacts on the health of aquatic organisms. Credit: Cheol Young Choi, Korea Maritime and Ocean University

The presence of plastics in our oceans and waterbodies is one of the most significant threats to marine ecosystems. In 2022, plastic production exceeded 400 million tons globally, which continues to rise. The presence of microplastics, ranging in size from 100 nanometers to 5 millimeters, is particularly concerning.

Owing to their small size, they can travel long distances in the oceans and can easily be ingested by a wide range of marine organisms, resulting in their accumulation in the food chain. Another aspect of microplastic pollution, often overlooked but equally dangerous, is its ability to absorb and carry harmful chemicals, such as persistent organic pollutants.

Benzo[α]pyrene (BaP), classified as a polycyclic aromatic hydrocarbon, stands out as a pollutant with significant concern. Produced as a byproduct of fuel and combustion processes, previous studies have reported BaP to be responsible for the induction of physiological stress and DNA damage in fish and other marine organisms.

Moreover, its slow degrading ability and carcinogenicity add to its worrisome nature. On being carried along with microplastics, which tend to act as carriers of pollutants owing to their hydrophobic surfaces, their accumulation in aquatic ecosystems can lead to enhanced toxicity in organisms that absorb these chemical substances. Understanding the extent of toxicity and threat posed by the combined impact of exposure to microplastics and other pollutants is, therefore, essential.

In a recent study now, researchers led by Dr. Cheol Young Choi from National Korea Maritime and Ocean University explored the impact of microplastic and BaP exposure on freshwater goldfish (Carassius auratus) who were exposed to BaP and microplastics individually and in combination to understand their exposure effects.

Their findings, published in *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology*, focused on the goldfish's stress response, including stress-related genes, cortisol levels, and DNA damage.

Elaborating further on their study, Dr. Choi explains, "When faced with harmful pollutants, organisms undergo a stress response for survival. In fish, we witness this through activating their stress-regulating axis, the hypothalamus–pituitary–interrenal axis, and releasing hormones like cortisol. While this response is essential for short-term survival, prolonged stress can disrupt the organism's overall health."

The experimentation revealed that in addition to affecting the endocrine system, exposure to pollutants could damage the organism's DNA. Both BaP and microplastics, when encountered separately, triggered abnormal effects in the goldfish.

However, on being exposed to both substances together, the goldfish experienced a stronger effect—more stress and DNA damage were observed compared to either substance alone.

"This is concerning because it shows that everyday pollutants, often found together in natural environments, can interact in particularly harmful ways, amplifying the negative effects they have on wildlife," says Dr. Choi, explaining the findings. The concentration of these pollutants in our aquatic ecosystems is indeed worrying, and they not only affect aquatic life but also have potential implications for human health.

Comprehensively understanding the compound effects of toxins on being combined, beyond their already harmful individual impacts, is essential for developing more effective and targeted strategies to deal with this multifaceted problem.

While the chemical effects of microplastics on marine life have been relatively understudied compared to other pollutants like BaP, this study brings to light new evidence that emphasizes the importance of considering their combined effects with other pollutants.

More information: Jin A Kim et al, Micro-polystyrene plastic and benzo[α]pyrene exposure affects the endocrine system and causes physiological stress in Carassius auratus, *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology* (2023). DOI: 10.1016/j.cbpc.2023.109695

Provided by National Korea Maritime and Ocean University