

Title of Research:

19_R05-01

Establishment of medaka kinetic model for aged microplastic and adsorbed chemical

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Summary of Research:

Plastic has extensive use in our daily life due to its low cost, lightweight, and hard to decompose. Due to their high production and slow degradation, plastic pollution has expanded worldwide in aquatic environments. Pollution of plastic from large items to small particles (microscopic plastic MP, < 5mm) emerged. The effect of MP and its vector effect with pollutants are of concerns. Many researchers have studied these topics. However, most of study were used pristine MPs. Thus, the study on effect of aging on vector effect of MP is required.

First, commercially available polyethylene pellets were used to produce grind polyethylene microplastics (cgPE-MP, 200 μ m), and then this MP was aged by exposure to UV irradiation equivalent to 5 years in a real environment (acgPE-MP).

Next, effect of aging on anthracene (ANT) uptake on medaka fish was examined using the cgPE-MP and acgPE-MP. No apparent difference was observed in ANT concentrations of fish between cgPE-MP and acgPE-MP co-exposure treatments. This result might be attributed to decrease of ANT concentration in water phase caused by absorption of ANT to cgPE.

The results of a follow-up test using sphere PE-MP (sPE-MP) and cgPE-MP showed that the concentration of ANT in the water was reduced to 87% and 73%, respectively. Simulation results showed a vector effect of sPE-MP and cgPE-MP co-exposure group.

3-year studies have confirmed the vector effect on ANT for PE and PS-MP (approximately 200 μ m, 40 mg/L). There seemed to be no significant difference in vector effect due to shape (sphere or grind) or aging. The cPE-MP also showed that it could strongly bind to ANT in water and reduce ANT concentration in the fish.

Furthermore, a PE-MP-ANT dual one-compartment model was constructed to predict vector effect in real environment, and it was estimated that the vector effect would be apparent at high MP concentrations (40 mg/L), but that the vector effect on ANT would be weak at low MP concentrations (0.1 mg/L, similar to the real environment). In the future work, it is necessary to construct vector effect prediction model that considers MP quality,

Timeline:

March 1, 2019 – Feb 1, 2022

Topics:

Publications:

- 1) Qiu, X., Saovany, S., Takai, Y., Akasaka, A., Inoue, Y., Yakata, N., Liu, Y., Waseda, M., Shimasaki, Y., Oshima, Y., 2020. Quantifying the vector effects of polyethylene microplastics on the accumulation of anthracene to Japanese medaka (*Oryzias latipes*). *Aquatic Toxicology* 228, 105643.
- 2) Assas, M., Qiu, X., Chen, K., Ogawa, H., Xu, H., Shimasaki, Y., Oshima, Y., 2020. Bioaccumulation and reproductive effects of fluorescent microplastics in medaka fish. *Mar. Pollut. Bull.* 158, 111446.
- 3) Liu, Y., Qiu, X., Xu, X., Takai, Y., Ogawa, H., Shimasaki, Y., Oshima, Y., 2021. Uptake and depuration kinetics of microplastics with different polymer types and particle sizes in Japanese medaka (*Oryzias latipes*). *Ecotoxicol. Environ. Saf.* 212, 112007.