Title of Research: 25-4-01

Quantitative assessment of the pharmacokinetics of MP as vectors in fish: Implementation of a novel digestive tract administration technique

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Summary of Research:

The array of microplastic (i.e., MP) pollution in marine ecosystems has been expanding due to greater bioavailability, leading to frequent detection in organisms, including fish, in natural habitats. Recent detection of MPs in the gastrointestinal tracts of marine fish raises concerns of possible translocation within the blood, internal organs, and tissues. Although a few reports claim the presence of MPs in various fish organs, understanding the quantitative translocation, expansion, and mechanisms remains limited. Challenges arise in laboratory-based analysis of quantitative expansion and translocation of MPs within the body, as volunteer feeding often accompanies baseline variability. Thus, to address the knowledge gap and create a robust and reproducible database, the current study aimed to develop a tube-feeding method that enables MPs to control oral administration in the digestive tract, thereby reducing variability in ingestion rate. The prototype was constructed prior to measuring changes in mouth diameter, length from the mouth to the stomach, and esophageal diameter in red sea bream juveniles (i.e., *Pagrus major*; approximately 10–30 g and 8–12 cm of total length). Then, the feed viscosity was evaluated for the conventional feed mixtures (e.g., Otohime EP2; Nissin Marubeni Feed) by inserting a syringe into each feed composition and measuring the force required to move the feed using a digital force gauge. After that, the tolerable volume of feed and MPs was measured based on the stomach's bearing capacity to design the tube-feeding device. Consequently, the tube-feeding device was constructed using a 1 ml syringe and a Teflon tubing (inner × outer diameter = 3 × 4 mm).

The red sea bream juveniles were chosen as the model species based on their ability to tolerate handling stress during our initial trial in the current study. Initially, the effectiveness of the design was tested by administering MPs with a diameter of 250–300 μm (spherical, fluorescent, yellow) to red sea bream juveniles weighing 10 and 30 g (n = 3). The excreted MP particles were counted, and the recovery rate consistently exceeded 90%, demonstrating the technique's higher reproducibility. Additionally, the retention time of MPs (e.g., 250–300 and 10–20 μm diameter spherical fluorescent; green) in the digestive tract was assessed in red sea bream juveniles, and the temporal pattern of MP excretion was recorded. The results demonstrated that 90% of the administered dose was excreted within 30 hours, regardless of MP size or fish body weight, indicating the suitability and reliability of the established technique for assessing the pharmacokinetics of MP and related vector effects.

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