Title of Research: **25-4-06**

Characterization of Microplastic Effects on Aquatic Organisms and Proposal of New Guidelines for Ecotoxicity Testing

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Summary of Research:

Microplastics (MPs) have been detected in aquatic environments, the atmosphere, and living organisms, raising concerns about their ecological impacts. However, current ecotoxicity tests were designed mainly for water-soluble chemicals and are not well suited for particulate materials such as MPs. In particular, testing methods that consider particle-specific properties—including particle size, surface characteristics, sedimentation behavior, and ingestion dynamics—are still insufficiently developed.

In this study, potential physical effects of MPs and the hypothesized mechanism of nutritional inhibition due to gastrointestinal blockage were examined using Daphnia magna. Polystyrene particles with diameters of 31.4, 10.5, 3, and 1 μm were tested. A modified extended acute toxicity test was conducted: the first 48 h followed OECD Test Guideline 202 under non-feeding conditions, after which algae were supplied and observations continued to 96 h. Toxicity of the supernatant from centrifuged commercial MP suspensions was also evaluated.

No significant effects were observed for 31.4 μm and 10.5 μm particles, whereas increased mortality occurred for 3 μm and 1 μm particles after 48 h despite feeding. Microscopy showed accumulation of small particles in the digestive tract, although MPs were also excreted, indicating that complete intestinal blockage did not occur. The results suggest that the observed effects are more likely caused by competition between food particles and MPs during ingestion, leading to reduced nutritional uptake. Adhesion of 1 μm particles to the body surface was also observed, suggesting possible physical interference with body surfaces or gill structures.

Strong acute toxicity was detected in the supernatant of commercial MP suspensions within 48 h, indicating that additives such as dispersants or preservatives may contribute to the observed toxicity. These findings suggest that studies using untreated MP suspensions may confound additive toxicity with the intrinsic effects of MPs.

Overall, MP toxicity assessment should consider both particle properties and additives in test materials. The results indicate that MP effects are better explained by nutritional inhibition due to competition with food particles rather than intestinal blockage.

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Topics:

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Publications:

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