

Dietary uptake pattern affects bioaccumulation and biomagnification of hydrophobic organic compounds in fish

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Biomagnification of hydrophobic organic compounds (HOCs) increases their eco-environmental risks. Lipid-water partitioning theory cannot fully address biomagnification. Here, we gained mechanistic insights on biomagnification of HOCs in fish from the kinetics. A new kinetic model describing the accumulation of HOCs in fish via waterborne and dietary uptake was established to consider discrete dietary uptake, while the conventional model regards dietary uptake as a continuous process. Bioaccumulation of the deuterated polycyclic aromatic hydrocarbons (PAHs-d10) in zebrafish was conducted with a passive dosing method in order to maintain the freely dissolved concentrations at ng L^{-1} . The PAH-d10 steady-state concentrations in zebrafish did not increase significantly with additional dietary uptake from *Daphnia magna* (with ng g^{-1} PAHs-d10), but they increased markedly with additional dietary uptake from spiked fish food (with $\mu\text{g g}^{-1}$ PAHs-d10). The results indicated that the intake amount of the PAHs-d10 played an important role in affecting their steady-state concentrations. Moreover, the peak concentrations in zebrafish after each dietary uptake make conventional kinetic model regarding dietary uptake as a continuous process underestimate the risks of the PAHs-d10. Considering the randomness of predation in natural situations, the Monte Carlo simulation showed that the probability distributions of biomagnification of the PAHs-d10 in zebrafish via trophic transfer from *Daphnia magna* increased with the dietary uptake frequency and amount of the PAHs-d10. The discontinuity and randomness of dietary uptake results in unpredictability of biomagnification, which may explain the among-aquatic ecosystem differences and provide new insight for analyzing experimental and field bioaccumulation data in the future.