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Evaluation of PCB bioaccumulation patterns in white sea urchins (*Lytechinus pictus*) using multiple approaches

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ABSTRACT

The bioaccumulation of polychlorinated biphenyls (PCBs) from three amended fieldcontaminated sediments (with total PCB concentrations of ~ 4, 10, and 100 µg/g-dry wt) by white sea urchins (*Lytechinus pictus*) was evaluated using multiple statistical and theoretical approaches. Similarity analysis of the PCB bioaccumulation patterns, based upon the concept of ecological communities, showed that the PCB patterns in the sea urchins and source sediments were essentially identical for all three sediment concentrations. However, affinity analysis did show some preference for bioaccumulation of higher molecular weight and more hydrophobic congeners by the urchins. The affinity analysis also showed that with a homologous series, bioaccumulation increased with increasing hydrophobicity. The biota-sediment accumulation factor (BSAF) profiles for the two lower concentration sediments (A and B) were found to be statistically different from the high concentration sample (Sediment C) by a multivariate analysis of variance (MANOVA). The relationship between the measured apparent organic carbon normalized partition coefficients (K_{OC}) and octanolwater partition coefficient (K_{OW}) (log-based) suggested a significant departure from thermodynamic equilibrium. A nonequilibrium, steady-state bioaccumulation model was found to correctly predict the observed experimental bioaccumulation patterns. To improve the model performance, a hydrophobic term was introduced to account for the drop-off in BSAF profiles with log $K_{OW} \geq 6.5$. This study showed that nonequilibrium, steady-state models are far superior to equilibrium partitioning-based models for understanding the bioaccumulation of organic chemicals by sea urchins.

Full Text

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