

Abstract for Society of Environmental Toxicology and Chemistry, 2011 National Meeting

Arsenic Toxicity to Juvenile Fish: Effects of Exposure Route, Arsenic Speciation, and Fish Species

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Arsenic toxicity to juvenile rainbow trout and fathead minnow was evaluated in 28-day tests using both dietborne and waterborne exposures, both inorganic and organic arsenic species, and both a live diet and an arsenic-spiked pellet diet. Effects of inorganic arsenic on rainbow trout growth were elicited when dietary concentrations were $>10 \mu\text{g As/g dwt}$, but no effects of dimethylarsinate, monomethylarsonate, and arsenobetaine on growth were observed at dietary concentrations at least 10-fold higher. Exposure of the live diet organisms to either arsenite or arsenate resulted in similar relationships of fish growth to dietary concentration, because arsenate was reduced to arsenite in the diet. For arsenite, dietborne exposure growth effects were similar whether a live or pellet diet was used. Waterborne exposures of rainbow trout to $\geq 16 \text{ mg As/L}$ of arsenate resulted in both growth reductions and mortality, but these water concentrations were much greater than those needed to contaminate live diet organisms enough to elicit growth effects. When growth effects were based on accumulation in the fish, waterborne and dietborne exposures showed similar dosimetry and were roughly additive. Fathead minnows were more sensitive than trout to mortality from waterborne exposure, but less sensitive to growth effects from dietborne exposure.