SCCWRP #0298

Differential toxicity of three polychlorinated biphenyl congeners in developing sea urchin embryos

Linda E. Schweitzer[1], Jo Ellen Hose[2], I.H. Suffet[1], and Steven M. Bays[3]

[1]Department of Environmental Health Sciences, School of Public health, University of California—Los Angeles, Los Angeles, CA
[2]Department of Biology, Occidental College, Los Angeles, CA
[3]Southern California Coastal Water Research Project, Westminster, CA

ABSTRACT
The relationship between body burden and toxicity of three individual polychlorinated biphenyl (PCB) congeners in developing sea urchin embryos was investigated to evaluate the validity of current predictive models of PCB toxicity in an invertebrate system. Body burdens of radiolabeled PCB (IUPAC 47, 77, and 153) accumulated from seawater were used to determine median effective concentration (EC50s) for developmental and cytogenic effects following a 72-h exposure. Congener 47, a di-*ortho*-substituted tetrachlorobiphenyl, was found to be at least four times more toxic than congener 77, a non-*ortho*-substituted (coplanar) tetrachlorobiphenyl, with EC50s of 47 and >218 mmol/kg, respectively, using an embryo development assay. This result contradicts the structure-activity prediction of the mammalian-based toxic equivalents (TEQs) approach, demonstrating the need for an ecotoxicological model. Congener 153, a di-*ortho*-substituted hexachlorobiphenyl, was virtually nontoxic in terms of developmental effects at the highest dose (102 mmol/kg) achievable at its limit of water solubility. Cytogenic analysis was a more sensitive method for assessing toxicity than the embryo development assay. Dose-response relationships were established with mitotic activity being the most sensitive endpoint because the PCBs appeared to inhibit mitosis. At the highest doses, complete mitotic arrest was observed. Congener 77 was found to be at least two times more toxic (EC50 < 16 mmol/kg) than congener 153 (EC50 = 67 mmol/kg) but not as toxic as congener 47 (EC50 < 16 mmol/kg) using mitotic activity as the endpoint for toxicity. Thus, the developmental and cytogenetic endpoints ranked the toxicity of the congeners similarly, but established different EC50s.

Keywords: Polychlorinated biphenyl congeners, toxicity, structure-activity relationship, sea urchin