AN EVALUATION OF THE INFLUENCE OF DIFFERENT SOIL CLEANUP LEVELS ON THE CONCENTRATION OF DIOXIN-LIKE COMPOUNDS IN HUMAN SERUM

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Introduction:

In 2009, the United States Environmental Protection Agency (USEPA) released a Science Plan for Activities Related to Dioxins in the Environment, a two-year roadmap for evaluating the health impact of dioxins. One of the components of this plan was to update the interim preliminary remediation goal (PRG), for dioxin-like compounds (DLCs). PRG values are used in screening and initial development of remedial alternatives prior to incorporating information from a site-specific risk assessment. As part of the Science Plan, the USEPA is conducting an evaluation of the basis for the PRG for DLCs. While the traditional USEPA approach involves developing PRGs based on intake dose and risk, we believe that a critical aspect of establishing an updated PRG for DLCs is an assessment of the impact that exposures to DLCs in soils have on human body burden. Thus, the objectives of this assessment were to use a physiologically-based pharmacokinetic model (PBPK) to (a) determine the impact of exposures to DLCs in soil on serum concentrations in humans, and (b) identify soil concentrations that, under exposure assumptions consistent with EPA practice, limit serum DLC levels so they do not exceed the identified target body concentrations corresponding to adequately protective exposure levels.

Materials and methods:

Daily intake associated with exposures to DLCs in soils was calculated using the traditional, default USEPA exposure scenario (0-30 yr old), conservative USEPA exposure parameters, and a range of soil concentrations (9.4 - 2000 ppt). Daily intake associated with lifetime exposures to DLCs from background sources was also included; background sources included in utero and breast milk exposures, as well as exposures to DLCs in the diet, etc. These values were then used in a concentration and age dependent PBPK model (based on Aylward *et al.* 2005 with minor adjustments) to model serum concentrations. When evaluating exposures with respect to cancer risk, the PBPK model was used to estimate the incremental lifetime average serum lipid concentrations (LASLC) associated with exposure to DLCs in soils. For non-cancer, the PBPK model was used to evaluate serum concentrations over time.

Results and discussion:
Comparison of modeled serum DLC concentrations associated with intake in soils to those predicted based on acceptable intakes established by regulatory agencies demonstrated that even at 2000 ppt in soil, modeled serum concentrations were below those based on intakes associated with ingestion of the lower bound of the acceptable range of TDI established by JECFA (2.3 pg/kg-d). In terms of cancer, soil concentrations had to be in excess of 1000 ppt before serum DLC concentrations fell outside of those associated with the EPA acceptable risk range of 10-4 to 10-6 (based on a cancer slope factor of 156,000). When the cancer-based RfD (Simon et al., 2009) was used to estimate the target body concentration, all LASLCs were below the target body concentration, even at soil concentrations of up to 2000 ppt. Further, the maximum increment in serum lipid TEQ concentration associated with a 30-year exposure to DLCs in soils (concentrations ranging from 9.4 to 2000 ppt TEQ) was approximately 10 ppt TEQ.

The results of this modeling demonstrate that DLCs in soils contribute very little to DLCs in human serum. This study provides important information for understanding the influence of soil clean up levels on human body burdens.

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