Derivation of Toxic Equivalency Factors (TEFs) for Dioxin-Like Compounds in Humans and Wildlife

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A meeting was held at the Karolinska Institute, Stockholm, Sweden from June 15-18 to establish TEFs for PCDDs, PCDFs, and dioxin-like PCBs for both human and ecological risk assessment. Twenty-one scientific experts from seven countries participated in the deliberations and assessed all available data. This meeting was a follow-up to an initial consultation held August 9-10, 1996, in Bilthoven, The Netherlands on the derivation of TEFs for wildlife for PCBs, PCDDs, PCDFs, and other dioxin-like compounds. Previously, the WHO had sponsored a consultation in 1993, which had set TEF values for thirteen dioxin-like PCBs (Ahlborg et al., 1994). An extensive data base had been created by scientists at the Karolinska Institute for that initial effort which included all the available information on the relative potency of dioxin-like PCBs in laboratory mammals. The data base has now been expanded to include all the available data on the PCDDs and PCDFs in laboratory mammals, and an additional data base created to capture the available information on fish and birds. Criteria for inclusion of data have been previously described (Ahlborg et al, 1994). TEFs are consensus, order of magnitude estimates of the relative potency of compounds which are structurally related to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), biologically persistent, bind with high affinity to the Ah receptor, and elicit TCDD-specific biochemical and toxic responses. They are based on all the available data and involve scientific judgment. Data considered to determine the TEF values were prioritized based on in vivo studies being given greater weight than in vitro information, and effects which are clearly adverse being given more strength than biochemical changes. In the mammalian area, longer-term in vivo studies were given more weight than acute experiments.

Both the previously established International-TEFs for PCDDs and PCDFs (NATO, 1988) and the PCB-TEFs (Ahlborg et al, 1994) for human risk assessment were re-evaluated and revised in light of new data. TEFs for PCDDs, PCDFs, and coplanar and mono-ortho PCBs were established for both fish and birds, in addition to the revised TEFs for mammals and humans. Uncertainties associated with the determination and use of TEFs involve issues such as non-linearity, non-additivity in the presence of nondioxin-like compounds, and the potential role of nonhalogenated, nonpersistent Ah receptor ligands in eliciting Ah-receptor mediated responses. Validation of the TEF approach was demonstrated by discussion of in vitro data using both synthetic and real-world mixtures, in vivo laboratory data involving fish, birds, and mammals with both complex synthetic and real-world mixtures, and ecological field studies. Future needs for research were identified.

The TEFs established for mammals/humans, fish, and birds by this expert working group convened under the auspices of the European Centre for Environment and Health as well as the International Program for Chemical Safety will be presented and discussed.