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Identification of Dioxin Metabolites in the Poisoning Case of Victor Yushchenko

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In autumn 2004, the current Ukrainian president, Victor Yushchenko, suffered a severe dioxin poisoning. First blood serum levels of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), measured in December 2004, were 110'000 pg/g lipid weight. These blood serum levels were more than 50'000 times higher than those in the general population and represent the second highest ever measured concentrations of TCDD in a human. We monitored the levels of TCDD and its metabolites for more than three years in various samples of blood serum, adipose tissue, skin, urine, faeces, and sweat of Victor Yushchenko. The work was only possible thanks to the cooperation and expressed consent of Victor Yushchenko.

For the first time in a human, two polar metabolites of TCDD, 2,3,7-trichloro-8-hydroxydibenzo-*p*-dioxin and 1,3,7,8-tetrachloro-2-hydroxy-dibenzo-*p*-dioxin were identified in serum, faeces, and urine using gas chromatography–high resolution mass spectrometry. Highest amounts of these metabolites were detected in faeces whereas serum and urine contained only traces. The relative amount of TCDD metabolites excreted *via* faeces accounts to approximately 40% of the totally eliminated TCDD *via* this route. As only small amounts of TCDD metabolites were detected in urine, renal excretion of these transformation products can be considered as a minor elimination pathway. In serum, the relative amount of metabolites was 50 times lower than in faeces, probably due to the rapid elimination of the metabolites after formation in the liver by phase I and II enzymes and transferred *via* the bile to the intestine. In our analyses, 98% of the total loss of the toxin and its metabolites could be recovered by the above-mentioned different elimination routes. **The elimination half-life of TCDD determined in Victor Yushchenko was 15.4 months, being much shorter than the half-life of 5–10 years reported for humans in the literature. Obviously, the strongly elevated TCDD blood serum levels caused the induction of detoxifying enzymes responsible for the transformation and elimination of the toxin.**

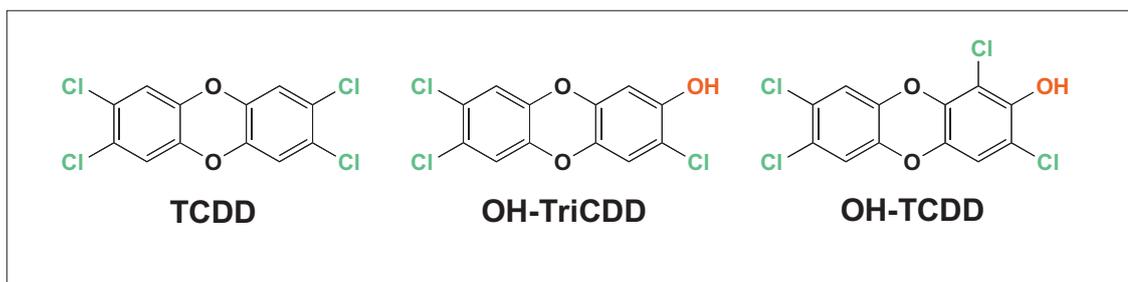
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O. Sorg, M. Zennegg, P. Schmid, R. Fedosyuk, R. Valikhnovskiy, O. Gaide, V. Kniazevych, J.-H. Saurat, *The Lancet* **2009**, *374*, 1179.



Victor Yushchenko before the dioxin poisoning (A), 3.5 months (B), and 3.5 years (C) after the poisoning incident



Structures of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and the two metabolites 2,3,7-trichloro-8-hydroxydibenzo-*p*-dioxin (OH-TriCDD) and 1,3,7,8-tetrachloro-2-hydroxydibenzo-*p*-dioxin (OH-TCDD)

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