

Human Ingestion of Chromium (VI) in Drinking Water: Pharmacokinetics Following Repeated Exposure

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Regulatory agencies have established safe drinking water concentrations for hexavalent chromium [Cr(VI)] based in part on the presumed capability of human gastric juices to rapidly reduce Cr(VI) to nontoxic trivalent chromium [Cr(III)] prior to systemic absorption. This study examines dose-related pharmacokinetics in humans following repeated oral exposure to Cr(VI) in drinking water. In particular, we sought to examine whether plausible drinking water exposures to Cr(VI) caused a sustained increase in red blood cell chromium levels, a specific marker for systemic uptake of Cr(VI). Adult male volunteers ingested a liter (in three volumes of 333 ml, at approximate 6-hr intervals) of deionized water containing Cr(VI) concentrations ranging from 0.1 to 10.0 mg/liter. Samples of urine, plasma, and red blood cells were collected and analyzed for chromium. A dose-related increase in urinary chromium excretion was observed in all volunteers. Red blood cell and plasma chromium concentrations became elevated in certain individuals at the highest doses. The RBC chromium profiles suggest that the ingested Cr(VI) was reduced to Cr(III) before entering the bloodstream, since the chromium concentration in the RBCs dropped rapidly postexposure. These findings suggest that the human gastrointestinal tract has the capacity to reduce ingested Cr(VI) following ingestion of up to 1 liter of water containing 10.0 mg/liter of Cr(VI), which is consistent with USEPA's position that the Cr(VI) drinking water standard of 0.10 mg Cr(VI)/liter is below the reductive capacity of the stomach.