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Absorption and Elimination of Trivalent and Hexavalent Chromium in Humans Following Ingestion of a Bolus Dose in Drinking Water

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These studies investigate the magnitude and valence state of chromium absorbed following plausible drinking water exposures to chromium(VI). Four adult male volunteers ingested a single dose of 5 mg Cr (in 0.5 liters deionized water) in three chromium mixtures: (1) Cr(III) chloride ($CrCl_3$), (2) potassium dichromate reduced with orange juice (Cr(III)-OJ); and (3) potassium dichromate [Cr(VI)]. Blood and urine chromium levels were followed for 1–3 days prior to and up to 12 days after ingestion. The three mixtures showed quite different pharmacokinetic patterns. $CrCl_3$ was poorly absorbed (estimated 0.13% bioavailability) and rapidly eliminated in urine (excretion half-life, ~10 hr), whereas Cr(III)-OJ was absorbed more efficiently (0.60% bioavailability) but more slowly (half-life, ~17 hr), and Cr(VI) had the highest bioavailability (6.9%) and the longest half-life (~39 hr). All three chromium mixtures caused temporary elevations in red blood cell (RBC) and plasma chromium concentrations, but the magnitude and duration of elevation showed a clear trend (Cr(VI) > Cr(III)-OJ > $CrCl_3$). The data suggest that nearly all the ingested Cr(VI) was reduced to Cr(III) before entering the bloodstream based on comparison to RBC and plasma chromium patterns in animals exposed to high doses of Cr(VI). These findings support our prior work which suggests that water-soluble organic complexes of Cr(III) formed during the reduction of Cr(VI) *in vivo* explain the patterns of blood uptake and urinary excretion in humans at drinking water concentrations of 10 mg/liter or less.