

## PaLMS (PATHOLOGY NORTH) TRACE ELEMENTS FACT SHEET

# CHROMIUM

### Introduction

Atomic mass 52. Chromium occurs as its oxide in chromite ore that also contains various amounts iron, aluminium and manganese. Chromium exists in valence states 3+ and 6+ and each of these has significantly different properties. The oxidation state determines toxicity, metabolism and excretion.

### Exposure

Chromium is present in a normal diet at trace (but essential) levels. Occupational exposure is related to the industrial uses of chrome compounds in production and use of steels, pigments, leather tanning and wood preservation solutions, plating chemicals, and cement.

Chromium is present in solutions used for total parenteral nutrition as a contaminant. The use of such unsupplemented solutions has been reported to be associated with elevated serum chromium. The use of supplemented solutions (0.2 mg/kg) has been associated with serum chromium levels twenty-fold greater than controls.

### Absorption

Cutaneous absorption of hexavalent forms has been demonstrated. Pulmonary absorption is related to water solubility. Very little chromium is absorbed in the gut.

### Distribution

Chromium is oxidised or reduced to yield the chromium 3 ion that circulates as a transferrin complex. Chromium is distributed diffusely in the body with generally higher levels found in kidney, liver, spleen and blood. Chromium does not appear to cross the blood-brain barrier.

### Excretion

Chromium is primarily excreted in the urine, a finding that accounts for the accumulation of the metal seen in renal failure.

### Pathology

No cases of toxicity have been described for excessive intake in the diet. However, there have been reports of toxicity with Cr<sup>3+</sup> picolinate (widely used in supplements) taken in doses many times that recommended (Cerulli J, Grabe DW, Gaithier I, Malone M, McGoldrick MD. Chromium picolinate toxicity. The Annals of Pharmacotherapy 1998;32:428-431).

Cr<sup>6+</sup> is highly toxic when inhaled and may result in lung cancer, dermatitis and skin ulcers. It is much less toxic when exposure occurs orally because gastric fluid readily reduces Cr<sup>6+</sup> to Cr<sup>3+</sup>. Toxicity is predominantly associated with industrial exposures. The most common presentation is an allergic eczema primarily on the skin but occasionally in the lungs. Some types of industrial exposure have been linked to increased prevalence of lung cancers. Acute exposure to high chromium concentrations can cause renal damage.

### Monitoring

Speciation of chromium in patient samples, that is specifically measuring just Cr<sup>6+</sup> (or Cr<sup>3+</sup>) rather than just the total chromium is actually of little use because Cr<sup>6+</sup> is reduced to Cr<sup>3+</sup> as soon as it enters a cell, causing cellular damage in the process.

Total urinary Cr is the usual laboratory test for exposure, however the test does not indicate specific exposure to Cr<sup>6+</sup>. The chromium absorbed demonstrates three clear half-lives of 7 hours, 20 days and 4 years. This should be taken into consideration when interpreting the data. Estimation of exposure risk is recommended over biological monitoring.

Chromium is an essential micronutrient and is suspected of playing a role in glucose tolerance. Impaired glucose tolerance has been reported in cases of suspected chromium deficiency. Normal serum chromium is at the limit of detection of current analytical systems. Where chromium is consistently undetectable there may be a case for cautious supplementation. Normal serum chromium levels are probably less than 8 nmol/L.

Samples taken for determination are notoriously prone to contamination by the collection equipment and storage tubes. Reference intervals at PaLMS Trace Element Service have been calculated to account for contamination present in the commercial collection tubes supplied by PaLMS. Please contact the laboratory for more information on the detection of presumed deficiency or collection procedures. The monitoring of elevated serum chromium in renal disease or after uncontrolled supplementation, or urine chromium is not compromised.

### **Treatment**

Recommended supplementation is 5-10 ug of chromic chloride daily for three days followed by 10 ug weekly. Monitor improvement in glucose tolerance.

### **Analysis**

Chromium concentrations are determined by inductively coupled plasma mass spectrometry.

**For further information please contact Ross Wenzel, PaLMS Trace Elements on (02) 9926 7682 or email [rwenzel@nscchahs.nsw.health.gov.au](mailto:rwenzel@nscchahs.nsw.health.gov.au).**