15. Chromium in Urine

Introduction

Chromium is an essential trace element necessary for the metabolism of carbohydrates and fats. In chromium deficiency a condition similar to diabetes is exhibited. Natural complexes that include chromium (e.g., brewers yeast) appear to be better absorbed from the GI tract than inorganic salts of chromium. Chromium enters the blood stream and is converted to chromium\(^{\text{III}}\) and is rapidly taken up in the tissues. As the tissues and blood are not in equilibrium with regards to chromium, the blood level is not a good indicator of chromium stores. About 80% of absorbed chromium is eliminated in the urine, so that urinary chromium levels can be used as an indication of body burden.

Chromium can also be absorbed through the lungs from chromate fumes and dust. Chromium exists in two main valency states, trivalent and hexavalent. Chromium\(^{\text{VI}}\) is better absorbed and more toxic than chromium\(^{\text{III}}\), and has also been listed as a carcinogen implicated in lung cancer. If absorbed Cr\(^{\text{VI}}\) is not converted to Cr\(^{\text{III}}\) in the red blood cells, acute kidney damage can occur.

Occupational exposure to chromium occurs in wood tanalising, stainless steel welding, chrome plating, the leather tanning industry and the use of lead chromate or strontium chromate paints.

Sample requirements

A 20 mL random urine sample is taken into a sterile container at the end of the shift at the end of the working week. Ensure that hands are washed and clothes are free of contamination. Urine arsenic can also be measured in the same sample. Refer to ‘Arsenic in Urine’ for the frequency of testing of timber treatment workers.
**Interpretation**

Non exposed levels $< 20$ nmol/L

Workplace Exposure Standards (1994)$^2$

(for exposure to soluble hexavalent chromium salts)

- Biological Exposure Index $600$ nmol/L (30 µg/L)

- Biological Exposure Index (BEI) - levels above which excessive exposure has occurred.

To ensure accurate assessment of exposure to chromium, urine samples must be collected at the end of the working shift or at the end of the working week if the exposure is continuous.

**Toxic effects**

The toxic effects of chromium are largely caused by the highly corrosive nature and solubility of chromate compounds used in industry.

**Skin:**

Skin contact causes allergic reactions and sensitisation. ‘Chrome Burn’, where the skin is broken, may lead to increased absorption and possible kidney damage.

**Inhalation:**

Acute inhalation of chromium fumes causes coughing, wheezing and fever may lead to kidney damage. The chromium$^{(VI)}$ compounds of low solubility are recognized as carcinogens from exposure by inhalation leading to lung cancer. Perforation of the nasal septum and chronic bronchitis are also consequences of chromium inhalation.

Urine chromium is used in occupational monitoring. Because chromium is rapidly eliminated from the system, a sample is taken at the end of the working week to give a good indication of exposure.