Chromium toxicity

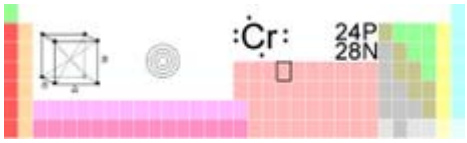
From Wikipedia, the free encyclopedia

Chromium toxicity refers to the toxic effects of chromium.

Water insoluble chromium(III) compounds and chromium metal are not considered a health hazard, while the toxicity and carcinogenic properties of chromium(VI) have been known for a long time.[1] An actual investigation into hexavalent chromium release into drinking water was used as the plot-basis of the motion picture *Erin Brockovich*.

Chromium toxicity

Classification and external resources



Chromium

ICD -10 T56.2 (http://apps.who.int/classifications/apps/icd/icd10online/?gt51.htm+t562)

ICD -9 985.6 (http://www.icd9data.com/getICD9Code.ashx?icd9=985.6)

Because of the specific transport mechanisms, only limited amounts of **chromium(III)** enter the cells. Several in vitro studies indicated that high concentrations of chromium(III) in the cell can lead to DNA damage.[2] Acute oral toxicity ranges between 1500 and 3300 µg/kg.[3] The proposed beneficial effects of chromium(III) and the use as dietary supplements yielded some controversial results, but recent reviews suggest that moderate uptake of chromium(III) through dietary supplements poses no risk.[2]

World Health Organization recommended maximum allowable concentration in drinking water for **chromium (VI)** is 0.05 milligrams per liter. [4] Hexavalent chromium is also one of the substances whose use is restricted by the European Restriction of Hazardous Substances Directive.

The acute oral toxicity for chromium(VI) ranges between 50 and 150 µg/kg.[3] In the body, chromium (VI) is reduced by several mechanisms to chromium(III) already in the blood before it enters the cells. The chromium(III) is excreted from the body, whereas the chromate ion is transferred into the cell by a transport mechanism, by which also sulfate and phosphate ions enter the cell. The acute toxicity of chromium(VI) is due to its strong oxidational properties. After it reaches the blood stream, it damages the kidneys, the liver and blood cells through oxidation reactions. Hemolysis, renal and liver failure are the results of these damages. Aggressive dialysis can improve the situation.[5]

The carcinogenity of chromate dust is known for a long time, and in 1890 the first publication described the elevated cancer risk of workers in a chromate dye company.[6][7] Three mechanisms have been proposed to describe the genotoxicity of chromium(VI). The first mechanism includes highly reactive hydroxyl radicals and other reactive radicals which are byproducts of the reduction of chromium(VI) to chromium(III). The second process includes the direct binding of chromium(V), produced by reduction in the cell, and chromium(IV) compounds to the DNA. The last mechanism attributed the genotoxicity to the binding to the DNA of the end product of the chromium(III) reduction.[8]

Chromium salts (chromates) are also the cause of allergic reactions in some people. Chromates are often used to manufacture, amongst other things, leather products, paints, cement, mortar and anti-corrosives. Contact with products containing chromates can lead to allergic contact dermatitis and irritant

dermatitis, resulting in ulceration of the skin, sometimes referred to as "chrome ulcers". This condition is often found in workers that have been exposed to strong chromate solutions in electroplating, tanning and chrome-producing manufacturers.[9][10][10]

In some parts of Russia, pentavalent chromium was reported as one of the causes of premature dementia.[11]

Environmental issues

As chromium compounds were used in dyes and paints and the tanning of leather, these compounds are often found in soil and groundwater at abandoned industrial sites, now needing environmental cleanup and remediation per the treatment of brownfield land. Primer paint containing hexavalent chromium is still widely used for aerospace and automobile refinishing applications.

Monitoring excessive human exposure

Overexposure to chromium can occur in welders and other workers in the metallurgical industry, persons taking chromium-containing dietary supplements, patients who have received metallic surgical implants and individuals who accidentally or intentionally ingest chromium salts. Chromium concentrations in whole blood, plasma, serum or urine may be measured to monitor for safety in exposed workers, to confirm the diagnosis in potential poisoning victims or to assist in the forensic investigation in a case of fatal overdosage.[12]

References

1. ^ Barceloux, Donald G.; Barceloux, Donald (1999). "Chromium". *Clinical Toxicology* **37** (2): 173–194. doi:10.1081/CLT-100102418 (http://dx.doi.org/10.1081%2FCLT-100102418) . PMID 10382554 (http://www.ncbi.nlm.nih.gov/pubmed/10382554) .
2. ^ ***a*** ***b*** Eastmond, David A.; MacGregor, JT; Slesinski, RS (2008). "Trivalent Chromium: Assessing the Genotoxic Risk of an Essential Trace Element and Widely Used Human and Animal Nutritional Supplement". *Critical Reviews in Toxicology* **38** (3): 173–190. doi:10.1080/10408440701845401 (http://dx.doi.org/10.1080%2F10408440701845401) . PMID 18324515 (http://www.ncbi.nlm.nih.gov/pubmed/18324515) .
3. ^ ***a*** ***b*** Katz, Sidney A.; Salem, H (1992). "The toxicology of chromium with respect to its chemical speciation: A review". *Journal of Applied Toxicology* **13** (3): 217–224. doi:10.1002/jat.2550130314 (http://dx.doi.org/10.1002%2Fjat.2550130314) . PMID 8326093 (http://www.ncbi.nlm.nih.gov/pubmed/8326093) .
4. ^ "WHO Guidelines on Drinking-Water Quality -- Chromium" (https://www.who.int/water_sanitation_health/dwq/chemicals/chromiumsum.pdf) . https://www.who.int/water_sanitation_health/dwq/chemicals/chromiumsum.pdf.
5. ^ Dayan, A. D.; Paine, AJ (2001). "Mechanisms of chromium toxicity, carcinogenicity and allergenicity: Review of the literature from 1985 to 2000". *Human & Experimental Toxicology* **20** (9): 439–451. doi:10.1191/096032701682693062 (http://dx.doi.org/10.1191%2F096032701682693062) . PMID 11776406 (http://www.ncbi.nlm.nih.gov/pubmed/11776406) .
6. ^ Newman, D. (1890). "A case of adeno-carcinoma of the left inferior turbinated body, and perforation of the nasal septum, in the person of a worker in chrome pigments". *Glasgow Med J* **33**: 469–470.
7. ^ Langard, Sverre (1990). "One Hundred Years of Chromium and Cancer: A Review of Epidemiological Evidence and Selected Case Reports". *American Journal of Industrial Medicine* **17** (2): 189–215. doi:10.1002/ajim.4700170205 (http://dx.doi.org/10.1002%2Fajim.4700170205) . PMID 2405656 (http://www.ncbi.nlm.nih.gov/pubmed/2405656) .

8. ^ M. D., Cohen; Kargacin, B; Klein, CB; Costa, M (1993). "Mechanisms of chromium carcinogenicity and toxicity". *Critical reviews in toxicology* **23** (3): 255–81. doi:10.3109/10408449309105012 (http://dx.doi.org/10.3109%2F10408449309105012) . PMID 8260068 (http://www.ncbi.nlm.nih.gov/pubmed/8260068) .
9. ^ "Chrome Contact Allergy" (http://dermnetnz.org/dermatitis/chrome-allergy.html) . DermNet NZ. http://dermnetnz.org/dermatitis/chrome-allergy.html.
10. ^ ***a*** ***b*** Basketter, David; Horev, L; Slodovnik, D; Merimes, S; Trattner, A; Ingber, A (2000). "Investigation of the threshold for allergic reactivity to chromium". *Contact Dermatitis* **44** (2): 70–74. doi:10.1034/j.1600-0536.2001.440202.x (http://dx.doi.org/10.1034%2Fj.1600-0536.2001.440202.x) . PMID 11205406 (http://www.ncbi.nlm.nih.gov/pubmed/11205406) .
11. ^ Chromium Toxicity (http://www.corrosion-doctors.org/Pollution/chromiumtoxicity.htm) on the Corrosion Doctors Web site maintained by Canadian Physical Chemist, Pierre R. Roberge, PhD, P.Eng. (access date 27 april 2009)
12. ^ R. Baselt, *Disposition of Toxic Drugs and Chemicals in Man*, 8th edition, Biomedical Publications, Foster City, CA, 2008, pp. 305-307.