

Chromium, A Heavy Metal with Both Beneficial and Harmful Effects: A Global Perspective

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ABSTRACT

Chromium is a heavy metal present in the atmosphere, water, soil and the biosphere. It is useful in the human body for metabolic activities as a trace element but its excess accumulation in the body through inhalation, prolonged contacts and ingestions in foods, drinks, and water could lead to toxicity leading to diseases. Due to its non-specific clinical presentations, and in the advent of toxicity in human body could go on over prolonged periods of time with probable wrong diagnoses and treatments as a result of health personnel capability and availability of both equipment and drugs. This short communication tries to re-awaken the consciousness of the medical community and the rest of the society about the dangers of chromium toxicity. This will help widen the scope of thinking horizon of health personnel managing patients presenting with varying and undefined clinical picture about the possibility of the involvement of chromium.

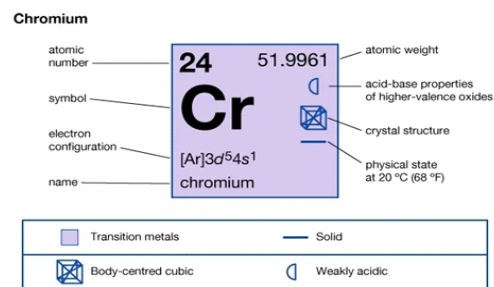
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INTRODUCTION

Elemental Chromium

Chromium (Cr) is a heavy metal that belongs to group VIb of the periodic table, and was discovered by the French Chemist Nicolas-Louis Vanquelin in 1797. An element with multiple colours from where its name is derived has an atomic weight of 51.9961, atomic number of 24, melting and boiling points of 1,890 °C (3,434 °F) and 2,482 °C (4,500 °F) respectively, and a specific gravity of 7.20 (at 28 °C). It is an abundant element in the crust of the earth and exists in compounds like iron chromite (FeCr₂O₄) also contaminating other metals such as aluminium, silicon, and manganese¹⁻⁴. Its primary

use in everyday life is the production of alloys with iron and nickel for industrial purposes owing to high resistance to corrosion by such combinations. Chromic oxide and Chromic acid are also its compounds with oxygen that are used for pigmentation and chromium plating respectively⁵⁻⁸.



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BENEFITS OF CR IN HUMAN BODY

Cr is an essential trace metal that aids metabolic activities in human body. It occurs in two forms: the trivalent chromium (Cr^{3+}) which is beneficial to human life and the hexavalent chromium (Cr^{6+}) which is toxic to human tissues. The trivalent Cr helps in glucose metabolism by improving the efficiency of insulin in the body and enhances general cellular functions, high athletic performance, treatment of diabetes and hypercholesterolaemia and dyslipidaemias. Its combinations can be used to treat obesity. Cr is obtained from foods and food supplements by ingestion mainly, and can also enter the body through inhalation and prolonged skin contact with Cr dust⁹⁻¹².

Toxic Effects of Cr

Cr toxicity in humans could manifest in the following clinical symptoms and signs: intense gastrointestinal irritation or ulceration and corrosion, epigastric pain, nausea, vomiting, diarrhea, vertigo, fever, muscle cramps, hemorrhagic diathesis, toxic nephritis, renal failure, intravascular hemolysis, circulatory collapse, liver damage, acute multisystem organ failure, cancers (lung cancer, cancer of paranasal sinuses and nasal cancers), and coma, and even death¹³⁻¹⁵. The various sources of Cr accumulation and toxicity from across the globe has been well documented as we brl water. It was observed that Cr levels were elevated and there was direct correlation with levels of detection of Mercury, indicating that detection of one metal could be an indication for contamination of another with probable shared common sources of contamination¹⁷. In a study on 57 agricultural soil samples in Jajmau and Kanpurin India showed widespread soil and ground water contamination which was chiefly from tannery effluents. These would no doubt contaminate all food crops grown and cultivated on such soils from bioaccumulation¹⁸. Cr pollution and toxicity has also extensively been documented in both western and eastern Europe: In north west Russia, Cr was found to be in high levels in drainage waters which was believed to be as a result of kimberlite magnetism, the levels were

however found not to exceed the maximum permissible concentrations (MPCs) approved by WHO. This contamination was said to emanate from diamond mining activity and there were strong concerns about bioaccumulation of Cr from fishes and subsequent biohazard to man¹⁹. And in Poland, there has been growing concerns over documented bioaccumulation of Cr in plants and animals, water, underground soil posing risks to human safety²⁰. Also in the Republic of North Macedonia, analysis of surface and underground water around the Metallurgical factory dump site in Jugohrom - Jegunovce showed elevated hexavalent chromium (Cr^{6+}) in the range of 0.052 – 132.98 mg/l from anthropogenic activities. This was above the 0.01g/l approved by the Macedonian and European standards in drinking water, and similar elevated levels were recorded in Latvia and Germany²¹⁻²³.

The situation in south America is no different: In Chile an analysis of Cr along with other heavy metals in *Ameghinomya antiqua*, *Aulacomya atra* and *Mytilus chilensis* caught along coastal towns of Pacific Ocean did not show significant elevation of Cr but there was elevated lead above MPCs and cadmium was found within normal range among the three metals studied. The elevation of one heavy metal among those tested in this ocean water is an indication for regular analysis of sea foods and greens associated with this body of water to ensure their safety from other heavy metal contamination/toxicity including Cr²⁴.

Findings from North America, Middle East and Australia have also shown that, even though Cr is useful for metabolic activity in the human body, its overdose through contamination and toxicity of fishes, vegetables, soils and water could be of immense danger to human health. They variously called for regular surveillance of environment and setting up of appropriate control and preventive measures²⁵⁻²⁷.

In conclusion, chromium is useful in our both social and medical needs, and can be acquired in foods both raw and processed, drinks, water, by body contacts and through inhalation. It can thus be injurious to

humans when it accumulates to toxic levels hence causing diseases. A regular check of environments, soils, foods and water should be maintained to ensure its accumulation in the environments does not exceed tolerable limits.

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