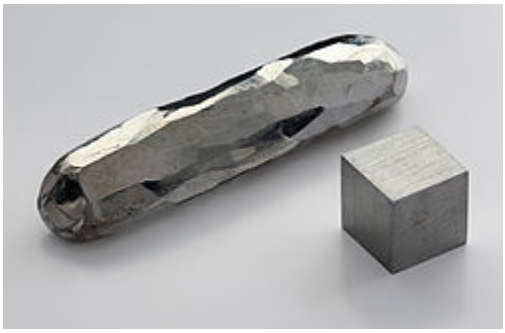
CADMIUM

Cadmium is a classic, elemental toxicant that shows various adverse effects and can be fatal depending on the dose. It is the most destructive in chronic exposure. It has caused many problems as an environmental toxicant (through incorrectly disposing of products containing cadmium) and toxicity is exhibited if ingested or inhaled



Chemical Structure

Cadmium is an element, it's chemical structure is simply one cadmium atom. It has an atomic number of 48 and atomic mass of 112 amu.

Uses of Cadmium

- Leather tanning agent/pigment in dye (until 1990's)
- Rechargeable Ni-Cd batteries
- Solar cells
- Solder alloys
- Paint and plastic production
- Engraving
- Cadmium vapor lamps
- Parasite treatment in farm animals
- Old television tubes
- Electroplate other metals

Information from "The facts on Cadmium" from Dartmouth Toxic Metals Research Program.

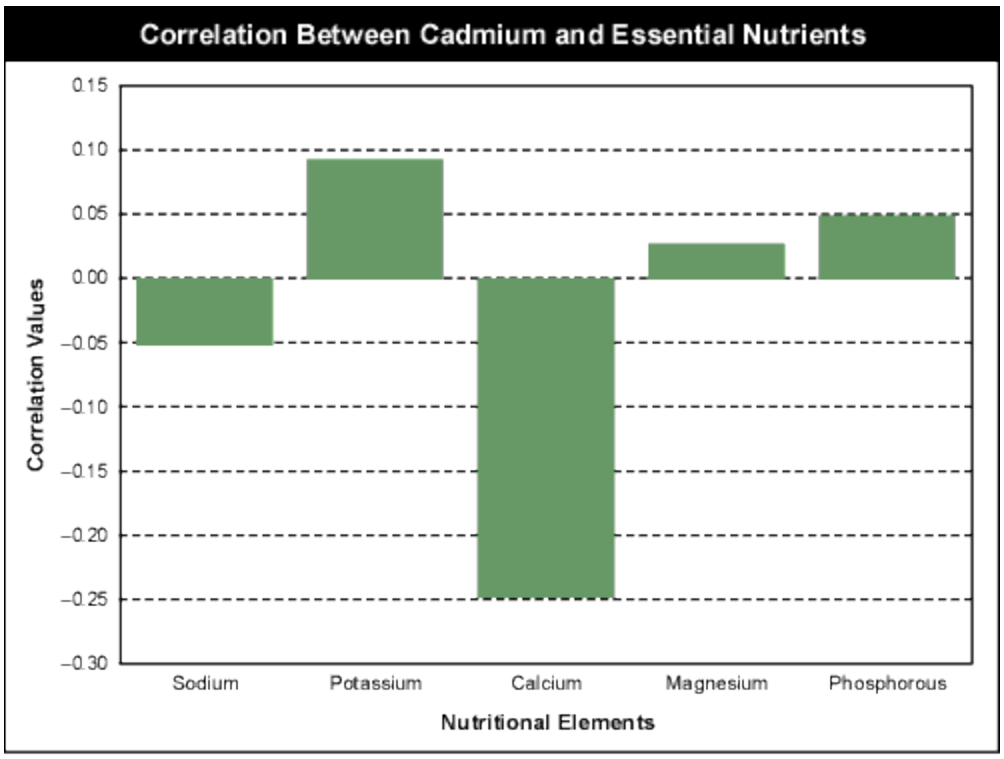
Opportunities for Exposure

Cadmium is released into the environment when coal or tobacco is burned (Dartmouth, 2005).These particles in the air can cause toxicity via inhalation. It is rarely found in the Earth's composition. Cadmium in the water is absorbed by fish and cadmium toxicity can be due to ingestion of the fish (especially shellfish) (Dartmouth, 2005). Most cadmium in the environment is due to pollution from waste and refining metal ores.

Physical/Chemical Properties Impacting Toxicity

Cadmium is most commonly found in a 2+ oxidation state in a salt, such as cadmium oxide, sulfide or sulfate(Bortman et al., 2003).The body is not able to metabolize more than only very small amounts. Small amounts are excreted along with metallothionein, but large amounts build up in the organs (Penney, 1993). Once cadmium is absorbed into the body, it is there to stay for a good part of a lifetime; it's half-life is 10 years (Darwish et al., 2002).There is no known mechanism, but it is thought that the fact that cadmium's 2+ oxidation state helps disguise it as calcium or zinc inside the body (Sutoo et al., 1990).

This graph illustrates the relationship between cadmium and calcium (and other 2+ oxidation state nutrients) in the body.



Source: NRDC

From "Healthy Milk, Healthy Baby"

Mechanisms of Toxicity

Besides cadmium's long half-life and the lack of the body's ability to metabolize it properly, there is no known mechanism of toxicity, although there are plenty of theories. When cadmium is absorbe into the body, it can replace zinc or calcium because they all have 2+ oxidation states and are similar in size when they are ionized, according toSutoo et al. (2002). Novelli et al. (2000) concluded that cadmium induces ROS, in turn changing metabolism.Congui et al. (2000) claim that their studies show that toxicity is caused by lipid peroxidation and free radical production. They also claim that cadmium inhibits glutathione peroxidases, so this results in less defense against the lipid peroxidation.

Adverse Health Effects

When cadmium is absorbed into the body in quantities greater than ten milligrams, adverse effects are acute and if over a long period of time, can be fatal (Longe, 2005). Cadmium causes damage to kidneys, cardiac tissue, bones and is thought to be a carcinogen (Bortman et al., 2003). Symptoms of cadmium exposure are increased loss of small proteins in the urine, salivation, choking, vomiting, metallic taste, loss of sense of smell, joint pain and others(Longe, 2005).

In the beginning, there begins to be excess small proteins such as retinol-binding protein in the urine. This is because the tubules are damaged and cannot reabsorb these proteins as they normally would. When there is long-term exposure, bigger proteins like albumin are let loose in the urine due to dysfunction of the glomerular membrane.

Research on Cadmium Toxicity

There have been many attempts to determine the mechanism of cadmium toxicity, leading to many theories, but no exact determination. Recently, there has been research performed to study the tolerance targets of cadmium by Thorsen et al., published in March 2009. The results show that genes and cellular functions are important in defending against toxicity. They have shown that phosphorylation of the Snf1p kinase contributes to cadmium tolerance (Thorsen, 2009). The research was performed by exposing Saccharomyces cerevisiae gene deletion yeast mutants to cadmium and monitoring their growth and screening (Thorsen, 2009). More information can be obtained from the actual publication.

Treatment

Cadmium poisoning is not reversible. It stays in the system for a very long time and will

be excreted along with metallothionein slowly. Hemodialysis has been used before to get rid of cadmium that has not been absorbed from the bloodstream yet and sometimes EDTA chelation can help increase the productivity of the procedure

Cadmium in the News

In the case of some Thai farmers, their exposure was due to cadmium being in the environment. Their rice fields produce "tainted rice" with five times the allowable level of cadmium. Now, they are showing the traditional signs of cadmium poisoning. Along with their rice turning black and being unfit to sell, the farmers have been complaining of constant joint pain and at least 40 deaths in the area are due to the pollution. It is unknown exactly where the cadmium is originating from, and the Thai government refuses to admit that any of the pollution is their fault

Source : http://www.toxipedia.org/pages/viewpage.action?pageId=2818958