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Analysis of the Need for a Copper (I) Supplement Pill

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1.Toxicity of copper (II):

The first point to make is that ingested copper (II) is very toxic. Evidence of that comes first from the Alzheimer's disease (AD) animal model studies of Sparks & Schreurs.[1] They administered tiny amounts of copper (0.12 ppm) in drinking water to a rabbit model of AD and showed greatly enhanced amyloid plaque formation in the brain and greatly increased memory loss. This is AD caused by tiny amounts of copper (II). Food copper could be increased from 3 ppm to 6 ppm, a 25 fold greater increase, and there would be none of this toxicity or any toxicity. Drinking water copper is all copper (II) and food copper almost all copper (I) as shown by Ceko et al.[2] Subsequently Sparks and colleagues[3] showed the same AD causing toxic effects of copper (II) (at 0.12 ppm) in the drinking water of several other animal models, and showed that aluminum and zinc were not toxic. The toxic effect of 0.12 ppm copper in the drinking water of a mouse AD animal model was shown in another laboratory.[4]

Morris and colleagues[5] in human studies showed that the highest quintile of copper intake, and only people taking copper containing supplements were in this quintile, lost cognition at 6 times the rate of other groups. Copper in currently available supplement pills is all copper (II). Mursa et al[6] have reported that mortality was 42% higher in older women taking copper [all copper (II)] containing supplement pills.

Conclusion number 1: it is clear that copper (II) is extremely toxic. It is as toxic to the brain as lead, but in a different way. Lead acts quickly to cause damage, including brain damage. Copper (II) acts over many years to cause cognition loss.

2. Some early data on mechanism of copper (II) toxicity:

In studies of Wilson's disease patients, my group found that with oral ingestion of copper (II) labeled with radioactive Cu64 that about 25% of the dose of copper appeared in the blood in the first 2 hours, far too fast to be metabolized by the liver.[7] If radioactive food copper, which is almost all copper (I), is given to humans, radioactive copper doesn't appear in the blood for 1 or 2 days, and then it is safely bound to proteins secreted by the liver into the blood.

Conclusion number 2: At least a sizable proportion of copper (II) ingested bypasses the liver, which puts copper into safe channels, and appears immediately in the blood free copper pool, where over time it is toxic to cognition. Ingested copper (I) is all metabolized by the liver and put into safe channels.

3. How we know food copper is primarily copper (I):

Ceko et al[2] have done very nice studies of the speciation of copper, that is, the valence of copper in various foods. They find that the copper in a variety of foods they studied is mostly copper (I). This was surprising since in living plant and animal tissues, copper forms a redox doublet, moving back and forth between copper (I) and copper (II), which helps catalyze key reactions critical to life. Thus, one would expect both copper (I) and copper (II) in foods. But apparently, at death or harvest, in the absence of oxygen transport the copper (II) is mostly reduced to copper (I).

4. The evolutionary significance of food copper being primarily copper (I):

The finding that food copper is primarily copper (I) is very important from the evolutionary standpoint. Copper is a potentially toxic element so the body needs to keep it in safe channels. But evolution can only respond to what the body sees. During evolution, human ancestry was primarily exposed only to copper (I) and not much copper (II). So there is a receptor in the intestinal cell, Ctrl,[8] which transports copper (I) through the intestinal wall to a system that transports it to the liver, where it is put into safe channels. Ctrl can't transport copper (II). Copper (II) enters the blood from the intestine by direct diffusion, and possibly by the divalent cation transporter. At least some of it bypasses the liver and is toxic to cognition, and possibly toxic in other ways.

Conclusion number 3: Human ancestry was exposed primarily to copper (I) and not very much to copper (II), so a safe path for copper (I) evolved. The 20th century has seen abundant exposure to copper (II) in developed countries from drinking water exposed to copper plumbing and from use of supplement pills containing copper (II), resulting in an epidemic of AD in developed countries in the 20th century.

5. Copper plumbing and AD:

The use of copper plumbing in developed countries has paralleled the AD epidemic. AD was unheard of before 1900, and now is present at about 44% of those age 75-84. Copper plumbing began to be used in the early 1900's, was curtailed by two world wars and then exploded after 1950 so that now 80-90% of U.S. homes have copper plumbing.[9] This is precisely what has happened to AD prevalence in developed countries. Undeveloped countries don't use copper plumbing because of the expense, and remain at a low (1%) prevalence of AD. Japan is a developed country with a low prevalence of AD, but they have shunned copper plumbing. But when Japanese migrate to Hawaii where copper plumbing is used, the prevalence of AD is similar to developed countries.

My group has documented the levels of copper in drinking water in 280 samples from all across N. America.[10] We found that about one third were above 0.1 ppm, the level found toxic in animal models. About one third were below 0.01 ppm, a level deemed safe, and about one third were between those values, levels of unknown safety. Thus, one third to two thirds of drinking water samples are unsafe or of unknown safety, if the AD animal model studies are a reasonable guide.

Conclusion number 4: It is concluded that copper plumbing has contributed strongly to the AD epidemic in developed countries by contributing copper (II) in the drinking water leached from the copper plumbing.

Overall conclusion: It is clear that ingestion of copper (II) is toxic. Yet all the copper supplement pills contain copper (II). A copper (I) supplement pill, such as that produced by MitoSynergy, is absolutely required for copper supplementation.

The role of copper (II) in causing the AD epidemic is summarized in several reviews, most notably, reference 11.

References

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