Importance of Copper and Copper Deficiency
Risks of Overdosing with Copper

by Prof. Joachim Schmidt

Copper is an essential trace element which has to be constantly supplied in sufficient quantities to the body. According to the guidelines of the German Society for Nutrition, the daily intake of 1.0-1.5 mg of elemental copper is recommended for adolescents and adults. Children require 0.2-1.0 mg daily, depending on their age. This copper requirement is usually covered by a normal diet. Foods which contain high quantities of copper are, for example, offal, crabmeat, lobster, nuts or whole grains.

Copper is an important cofactor of many enzymes such as cytochrome-c-oxidase, amino acid oxidase, superoxide dismutase and monoamine oxidase. In the human body, copper plays an important role above all with respect to growth, blood formation, iron metabolism, bone strength, cholesterol and glucose metabolism, cardiac muscle contraction, the immune system and the correct functioning of the nervous system (especially brain development). In the formation of blood, it is particularly important for the formation of haemoglobin. The synthesis of the pigment melanin, which is present in the skin and hair, also depends on this trace element. The development of the myelin sheath around the nerve fibres and the formation of connective tissue are supported. Copper influences the iron metabolism by on the one hand promoting the absorption of iron in the intestine, and on the other hand indirectly via the caeruloplasmin, one of whose functions is the transport of iron between the tissues, which is necessary for haemoglobin synthesis.

Copper deficiency is relatively rare. It can be caused by a highly unbalanced diet, by interference with the absorption of copper (malabsorption) or by prolonged artificial diet. The long term intake of zinc preparations can also result in copper deficiency. If children receive only cows' milk for a prolonged period, it is also possible that copper deficiency will occur.

The typical manifestations of copper deficiency include:

- anaemia
- reduced number of white blood cells
- malfunctions of the immune system
- pigment disorders in the skin
- disorders of the central nervous system
- impacts on growth

Individual studies have shown that the symptoms of copper deficiency can appear mainly in the case of premature and malnourished children. A possible relationship between copper deficiency and the occurrence of cardiovascular diseases is under discussion, but the evidence for this is currently insufficient. In examinations of individuals with a low copper intake, disorders that have been found are hypercholesterolaemia, ECG changes, impaired glucose utilisation and a hypertonic response to isometric muscle contraction. A poor copper status is also associated with postmenopausal osteoporosis. In children the effects are growth disorders and an increased susceptibility to infections.

The detection of copper deficiency is particularly difficult in the case of latent copper deficiency (the most common form of this deficiency). Determination of the copper concentration in the serum or in the urine does not alone provide any reliable data. Further meaningful parameters are the determination of the caeruloplasmin concentration and activity in the erythrocytes and the determination of the superoxide dismutase concentration. Detection is therefore difficult and costly in normal everyday medical practice. In the case of clinically apparent copper deficiency, low plasma copper levels, low caeruloplasmin levels, low superoxide dismutase levels, anaemia and neutropenia can be expected.

An overdose or poisoning with copper is extremely rare. The upper intake level (maximum quantity) at which according to international estimates no damage is to be expected even in the case of long-term intake (tolerable upper intake level [UL]) is stated as being 10 mg/day for copper. If larger quantities are consumed in the form of copper salts, this triggers retching, with copper salts also being poorly absorbed by the body. The first symptoms of copper intoxication can be expected from a dose of more than 10-15 mg of copper. The symptoms of intoxication are severe vomiting, diarrhoea, abdominal cramps and increased salivation. In addition, the patient may experience shock. In cases of diabetes, the intake of the birth control pill, during pregnancy, in some liver diseases, kidney stones and rheumatism, it is possible that the copper values in the blood will be raised.
High doses of several grams cause liver and kidney damage, haemolysis, brain damage, coma and death.
Toxic effects of copper are also found in Wilson’s Disease. This leads to the protracted storage of copper, above all in the liver and basal ganglia, and the occurrence of liver cirrhosis.
Drinking water may contain copper ions if the water pipes consist of copper and the water is allowed to stand still for a prolonged period. This is particularly problematic if children drink water from a copper container - for example from a watering can for room plants - in which the water has been allowed to stand for a prolonged period. Here the problem is that soluble copper salts also form. The chronic symptom was first observed in India and Germany (Indian/German Childhood Cirrhosis). These children suffered from severe liver cirrhosis and weakening of their immune system.

Prof. Dr. J. Schmidt
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