

Copper, copper toxicity, role of curcumin as detoxifying agent

Copper is a component of many proteins in the body, almost all copper in the body is bound to proteins, and its unbound (free) ions are toxic. In its natural state, copper is found in ore and is present in water [1].

The largest ore reserves are located in Chile - 34% of the world's total. The United States and Peru each has 9% of the fossil deposits, Australia - 6%. Eastern Siberia, the Urals and the Kola Peninsula account for 5%, in China - 4%, in Kazakhstan, Mongolia, Zambia, DR Congo, Mexico - 3% each, Canada, Argentina, Indonesia and the Philippines - 2% each, Poland - 1% [2].

Copper is used for the manufacture of cable products, power generators, telephone and telegraph equipment, radio equipment, air conditioners, coins, glass dyes, food additives, in art, ship hull plating, printed circuit boards, sewers, drains, door handles, dishes, mold removal, electrical wires, jewelry, lightning rods, microwave ovens, musical instruments, relays, conductors, waterproofing roofs, corrugated board, statues, various pipes, heat exchangers, vacuum apparatus, coated copper busbars [3].

Every day, people are in contact with many copper products, without realizing that some part of it enters the body every day with water and food [4], and long-term accumulation can detrimentally affect health [5].

It is known that the toxic effect of copper causes intravascular hemolysis [6], copper ions oxidize iron, resulting in the formation of methemoglobin [7]. This is followed by the development of a violation of the body's epithelial cells, mitochondrial [8] dysfunction [9], obstruction [10] of hepatocytes [11], which occur with leakage and cell modification [12].

Long-term exposure to copper causes a variety of disorders, such as:

- liver damage [13]
- kidney damage [14]
- gastrointestinal disorders [15]
- Wilson's disease [16] [17]

According to research data, curcumin is one of the best means for preventing the development of pathological processes in the body caused by toxins [18].

Curcumin is the main curcuminoid [19] found in turmeric root [20].

Curcumin is one of the most widely tested natural compounds. Laboratory studies have shown that curcumin is a therapeutically useful tool for preventing or correcting the negative effects of copper on the body. The mechanism of action of curcumin is due to a protective chelating effect [21], prevention of the development of oxidative stress, which occurs with an increase in the formation of ROS [22].

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Curcumin normalizes the concentration of liver enzymes [23], prevents their leakage into the blood serum, stimulates regeneration [24] of liver tissue, controls protein biosynthesis disorders [25], prevents the development of lipid peroxidation [26], normalizes urea levels [27] and creatinine [28]. Thus, curcumin prevents the body's destructive chain reaction to the toxic effects of copper [29] [30] [31] [32].

Furthermore, in laboratory conditions curcumin has demonstrated multiple pharmacological properties, including antioxidant, anti-inflammatory, anticarcinogenic, cardioprotective, hepatoprotective, antidepressant, immune-strengthening, and many others [33].

Unfortunately, these encouraging initial findings were not supported in human clinical trials due to the very low bioavailability of curcumin, which averaged no more than 0.1% [34]. This low bioavailability prevents curcumin from showing its therapeutic potential while taking as powder or extract.

It is worth noting that laboratory studies with curcumin have greatly increased interest in it all over the world, and this was especially evident in the segment of dietary supplements. On almost every supplement site, you can purchase preparations made from powder or turmeric extract and find information on the pharmacological effect of curcumin on dozens of diseases. This method of presenting information is a substitution of concepts, when laboratory findings are issued as clinical results. Neither turmeric extract, nor powder, is able to provide the pharmacological action that curcumin has shown in laboratory studies.

Increasing the bioavailability of curcumin has been the topic of many research teams for several decades [35]. Several technologies have already been developed to increase the bioavailability of curcumin. The most advanced technology for the delivery of active substances into the blood is liposomal [36].

Liposomal curcumin delivery technology allows to achieve the desired pharmacological effect in humans and animals, which has been demonstrated in thousands of laboratory studies [37] [38].

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