

# Abstract

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## The role of copper, molybdenum, selenium, and zinc in nutrition and health.

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**BACKGROUND:** Copper, zinc, selenium, and molybdenum are involved in many biochemical processes supporting life. The most important of these processes are cellular respiration, cellular utilization of oxygen, DNA and RNA reproduction, maintenance of cell membrane integrity, and sequestration of free radicals.

**DISCUSSION:** Copper, zinc, and selenium are involved in destruction of free radicals through cascading enzyme systems. Superoxide radicals are reduced to hydrogen peroxide by superoxide dismutases in the presence of copper and zinc cofactors. Hydrogen peroxide is then reduced to water by the selenium-glutathione peroxidase couple. Efficient removal of these superoxide free radicals maintains the integrity of membranes, reduces the risk of cancer, and slows the aging process. On the other hand, excess intake of these trace elements leads to disease and toxicity; therefore, a fine balance is essential for health. Trace element--deficient patients usually present with common symptoms such as malaise, loss of appetite, anemia, infection, skin lesions, and low-grade neuropathy, thus complicating the diagnosis. Symptoms for intoxication by trace elements are general, for example, flu-like and CNS symptoms, fever, coughing, nausea, vomiting, diarrhea, anemia, and neuropathy. A combination of observation, medical and dietary history, and analyses for multiple trace elements is needed to pinpoint the trace element(s) involved. Serum, plasma, and erythrocytes may be used for the evaluation of copper and zinc status, whereas only serum or plasma is recommended for selenium. Whole blood is preferred for molybdenum. When trace element levels are inconsistent with medical evaluations, a test for activity of the suspected enzyme(s) would support the differential diagnosis. Furthermore, it is important to differentiate whether trace element deficiency or toxicity is the primary cause of the disorder, or is secondary to other underlying diseases. Only successful treatment of the primary disorder will lead to complete recovery. In the event of sample contamination during collection or analysis, the physician may be misled by falsely elevated results. Royal blue top evacuated tubes containing negligibly low concentrations of the trace element or acid-washed plastic sterilized syringes should be used for blood, serum, or plasma collection. Powdered gloves must be avoided. When possible, mineral supplements are not to be administered to the patient for a minimum of 3 days prior to sample collection. Serum and plasma specimens are to be transported in acid-washed polypropylene and polyethylene tubes. Analysis is performed in a controlled environment to minimize or eliminate contamination. During analysis, all laboratory wares should be acid-washed for decontamination. A detailed description of these precautions may be found in reviews by Aitio and Jarvisalo and by Chan and Gerson.

**SUMMARY:** Copper and zinc analysis on serum and plasma are commonly performed by flame atomic absorption spectrometry, inductively coupled plasma-atomic emission spectrometry, and inductively coupled plasma-mass spectrometry. Serum and plasma selenium levels are determined by graphite furnace atomic absorption with Zeeman background correction and neutron activation analysis. Molybdenum levels are best determined by neutron activation and highly sensitive inductively coupled plasma-mass spectrometry.

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