

## TRACE MINERALS

Nutrient	Principal sources	Functions	Effects of Deficiency and Toxicity
Chromium	Liver, processed meats, whole-grain cereals, nuts	Promotion of glucose tolerance	<b>Deficiency:</b> Possibly impaired glucose tolerance
Copper	Organ meats, shellfish, nuts, dried legumes, dried fruits, whole-grain cereals, peas, cocoa, mushrooms, tomato products	Enzyme component, hematopoiesis, bone formation	<b>Deficiency:</b> Anemia in undernourished children, Menkes' (kinky-hair) syndrome <b>Toxicity:</b> Wilson's disease, copper poisoning
Fluorine	Seafood, tea, fluoridated water (sodium fluoride 1.0–2.0 ppm)	Bone and tooth formation	<b>Deficiency:</b> Predisposition to dental caries, possibly osteoporosis <b>Toxicity:</b> Fluorosis, mottling and pitting of permanent teeth, exostoses of spine
Iodine	Seafood, iodized salt, eggs, cheese, drinking water (content varies)	Thyroxine (T <sub>4</sub> ) and triiodothyronine (T <sub>3</sub> ) synthesis, development of fetus	<b>Deficiency:</b> Simple (colloid, endemic) goiter, cretinism, deaf-mutism, impaired fetal growth and brain development <b>Toxicity:</b> Hyperthyroidism or hypothyroidism
Iron	Many foods (except dairy products)—soybean flour, beef, kidney, liver, fish, poultry, beans, clams, molasses, enriched grains and cereals (bioavailability variable in plant sources)	Hemoglobin and myoglobin formation, cytochrome enzymes, iron-sulfur proteins	<b>Deficiency:</b> Anemia, pica, glossitis, angular cheilosis <b>Toxicity:</b> Hemochromatosis, cirrhosis, diabetes mellitus, skin pigmentation
Manganese	Whole-grain cereals, pineapple, nuts, tea, beans, tomato paste	Healthy bone structure Component of manganese-specific enzymes: glycosyltransferases, phosphoenolpyruvate carboxykinase, manganese-superoxide dismutase	<b>Primary deficiency:</b> Questionable <b>Toxicity:</b> Neurologic symptoms resembling those of parkinsonism or Wilson's disease
Molybdenum	Milk, legumes, whole-grain breads and cereals, dark green vegetables	Component of coenzyme for sulfite oxidase, xanthine dehydrogenase, and one aldehyde oxidase	<b>Deficiency:</b> Tachycardia, headache, nausea, obtundation (sulfite toxicity)

**TRACE MINERALS—Continued**

Nutrient	Principal sources	Functions	Effects of Deficiency and Toxicity
Selenium	Meats, seafood, nuts, plant-based foods (selenium content varying with soil concentration)	Component of glutathione peroxidase and thyroid hormone iodinase	<p><b>Deficiency:</b>            Keshan disease (viral cardiomyopathy), muscle weakness</p> <p><b>Toxicity:</b>            Hair loss, abnormal nails, nausea, dermatitis, peripheral neuropathy</p>
Zinc	Meat, liver, oysters, seafood, fortified cereals, peanuts, whole grains (bioavailability variable in plant sources)	Enzyme component, skin integrity, wound healing, growth	<p><b>Deficiency:</b>            Impaired growth and delayed sexual maturation, hypogonadism, hypogeusia</p> <p><b>Toxicity:</b>            RBC microcytosis, neutropenia, impaired immunity</p>