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TOXIC ELEMENTS

ELEMENT	Synergistic for uptake / retention	Antagonistic for uptake / retention	Sources	Physiological interactions	Symptoms of excessive exposure
ALUMINUM (Al)	Iron or calcium deficiency.	Adequate iron and calcium. Vitamin C (for all toxins)	Aluminum-containing baking powder, cookware, water, antacids, processed cheeses, antiperspirants, beverage cans, crafts, office supplies, industry.	Accumulates progressively in bone, liver, kidney, brain. Follows PO4. Inhibits isocitrate dehydrogenase in mitochondria, thus decreases alpha-keto-glutarate. Interference with bone mineralization, binds to brain calmodulin, may enhance acetylcholine turnover. Associated with neuronal plaques.	Headache, fatigue, bone pain, dementia. Low hemoglobin, hypophosphatemia, hyperammonemia.
ANTIMONY (Sb)	Magnesium or selenium deficiency.	Adequate magnesium, selenium, and methionine.	Tobacco, solder, metalwork, flame retardants in textiles, mordant in dyeing processes, rubber processing, mining, smelting.	Accumulates in adrenals, thyroid, kidney, liver, spleen, and bone. Clears rapidly from blood. Inhibits various enzyme systems (PFK, MAO). Binds to sulfhydryl groups.	Metallic taste, gout-like symptoms, angina, anorexia, fatigue, myopathy, hypotension, "antimony spots" if exposed to vapor.
ARSENIC (As)	Selenium or iodine deficiency. Cf. locotoxicity.	Adequate selenium and iodine.	Seafood (mussels, fish, oysters), pesticides, defoliants, chemical, electronic & photo-electric processes, specialty glass, water.	Organic forms readily absorbed, those inorganic forms in water are also easily absorbed. Deposits in liver, kidney, skin, spleen. Disables alpha-lipoic acid. Potential co-carcinogen and/or carcinogen. Binds to sulfhydryl and phosphatide groups.	Hair loss, white-streaked nails, myalgia, garlic odor, anorexia, hypopigmentation, hypotension, chest pain, diarrhea.
CADMIUM (Cd)	Iron deficiency. Lead and mercury accentuate toxicity.	Adequate zinc, calcium, magnesium, and copper.	Sewage sludge, seafood, tobacco, mining, phosphate fertilizers, soft water, welding.	Kidney proximal tubule is main site of accumulation. May modify catecholamine metabolism. Decreases CYP-450. Inhibits anti-trypsin. Changes in arterial endothelium seen.	Hypotension, hypertension, fatigue, anemia, proteinuria, osteomalacia, nausea, vomiting, diarrhea, emphysema.
LEAD (Pb)	Calcium, iron, zinc, and phosphate deficiencies increase absorption. Children/infants 40% higher absorption.	Calcium, zinc, and phytate decrease absorption.	Paints, ceramics, solder, soil, newsprint, dolomite, pewter ware.	Lead binds to hemoglobin, deposits in bone, aorta, kidney tubules, brain, adrenal, thyroid, liver. Inhibits heme synthesis, may depress mitochondrial respiratory chain. ATP-ases also affected.	Microcytic anemia, glycosuria, I.Q. loss, anorexia, metallic taste, insomnia, reticulocytosis.
MERCURY (Hg)	Selenium deficiency.	Adequate selenium.	Shellfish, large fish, dental amalgams, electrical relays, fungicides, mining, paints, explosives.	Accumulates in kidney, liver. Organic mercury has a 1/2 life of 2 months & binds to enzymes, proteins, and glutathione. MAO, catalase, P-450, and mitochondrial functions are affected.	Headache, fine tremor, increased salivation, excitability, poor mental concentration, metallic taste.
NICKEL (Ni)	Iron, copper, or zinc deficiencies.	Adequate manganese, zinc, and copper.	Cocoa, hydrogenated oils, chocolate, water, dental materials, plant foods (nuts), batteries (Ni-Cd).	Controversial nutrient role in humans, accumulates in kidney, liver, skin, brain. Hypersensitizes for inflammatory responses.	Dermatitis, allergies, increased inflammation.
THALLIUM (Tl)		Adequate potassium and selenium.	Semiconductor, photocell batteries (Ni-Cd) manufacture, optical glass. Zinc, cadmium, mining, smelting, toxic waste dumps.	Absorbed through skin, lungs, and via ingestion. Inhibits RNA and DNA synthesis. Inactivates riboflavin. Cholinesterase and phosphatase inhibited too. Accumulates in kidney, heart, muscle, brain.	Anorexia, alopecia, ataxia, mental confusion, tremor, hypertension, polyneuropathy, immune changes.
TIN (Sn)		Adequate zinc, iron, and copper.	Tin-coated cans, especially containing acidic foods, or juices. Processed foods. Industrial discharges.	Accumulates in liver, brain, and lymphatics. 1/2 life is 5-100 days. Decreases P 450 and oxidative phosphorylation.	Hyperglycemia, ataxia, headache, vision changes, liver pain.
URANIUM (U)	Calcium deficiency.	Adequate calcium and iron.	Water, soil, dust.	Accumulates in liver, kidney (prox. tubule, glomerulus), spleen, and bone.	Chronic fatigue, glycosuria, hyperaminoaciduria.