Toxicity: less than 2,000 mg of elemental iodine can be fatal; more than a few mg/day may lead to acne; more than 50 mg/day may cause reversible inflammation of salivary (parotid & submaxillary) glands;

Symptoms include metallic taste & sores in mouth, swollen salivary glands, diarrhoea & vomiting;

Therapy with Iodine

- Usual therapeutic dose is 100 - 1,000 mg/day;
- Alleviates symptoms of deficiency, including goitre;
- Has been used to relieve pain and soreness associated with fibrocystic breasts, that may be a symptom of iodine deficiency;
- Diiodothyronine, plus magnesium, copper & manganese relieves sore & heavy breasts & normalizes vaginal mucus; may also help keep cholesterol from forming, keep skin unwrinkled & keep breasts soft;
- 100 mg/day of iodine as potassium iodide for 7 to 14 days can protect from thyroid cancer due to uptake of radioactive iodine from nuclear fallout, by saturating thyroid tissue;
- Used in mucus-loosening (mucolytic) agents available by prescription;
- Externally, used to disinfect non-treated country water; excellent external antiseptic for wounds;

IRON (Fe)

General - trace mineral; blood mineral; oxygen carrier; backbone of energy production;

- Adult body contains 4 to 5 grams, roughly the amount in a small nail;
- Oxygen-carrying pigment of red blood cells (haemoglobin) accounts for 50% of body iron;
- Very old in evolution; probably first metal associated with protein, at beginning of oxygen-using (aerobic) life forms;
- History: symptoms of iron deficiency anaemia described by Egyptian physicians in 1500 B.C.; recognized as part of body tissues in 1713; use of iron to treat “chlorosis” (iron-deficiency anaemia) in humans described in mid-1700’s; value of iron in treating iron deficiency anaemia established in 1932;

Nutrition

- Sources: best: meats, esp. blood, liver & kidney; good: molasses, egg yolks, whole cereals, iron cooking pots, clams, fish spinach, asparagus, prunes; poor: fortified Fe in cereals is inorganic & poorly absorbed;
- Supplements: iron salts, acid salts, amino acid chelates, multi-mineral, multi-mineral-vitamin formulations;
- Absorption from upper part of small intestine; inefficient process; optimal iron absorption from animal sources is about 15%; absorption from plant sources is only about 4%; iron absorption rate governed by body’s need: an iron-anaemic person may absorb 50 - 60% of iron present in food;
- Improved by: acids (citric, ascorbic, hydrochloric, etc.); copper, B-complex vitamins; sufficient stomach HCl; protein; vitamin E, calcium, manganese, vitamin A;
- Antagonized by: phytic acid; oxalic acid; tetracycline & its derivatives; antacids; tea; bran; copper deficiency; soy protein can decrease iron absorption by up to 92%;
- Storage: 50% in red blood cells; remainder stored in blood serum, liver, spleen, bone marrow (site of red blood cell formation) and muscles; iron is stored in mobile depots, hollow protein shells (ferritin), each molecule of which can hold up to 4,500 iron atoms (usually less than 3,000);
• **Excretion:** iron is efficiently recycled; small amounts lost through urine, menstruation, sweat & skin wear; body has no way of excreting large amounts of iron;

• **Metabolism:** molybdenum is involved in iron metabolism; B-complex vitamins involved; higher requirements for iron in growth, pregnancy, aspirin use, wound healing & menstruation; inorganic iron destroys vitamin E; iron utilization impaired in rheumatoid arthritis, cancer, candidiasis & chronic herpes infection;

• **Interactions:** tetracycline, penicillamine, levodopa & cardiodopa bind iron, making it unavailable to the body; phytic & oxalic acids & EDTA also bind iron;

**Functions of iron**

• Part of haemoglobin in red blood cells, that carry oxygen to all parts of body through-out their 120 day life span; vitamins C, E, B-6 & B-12 & the amino acid glycine are necessary for red blood cell formation;

• Part of myoglobin in muscles, a reservoir of oxygen for muscles that makes sustained muscular activity possible;

• Iron participates in energy-producing reactions (cytochromes of Krebs cycle) in all cells, activates energy-producing oxidizing enzymes, necessary for synthesis of carnitine that transports fats to be oxidized for energy; helps regulate blood fats;

• May boost physical performance, due to its role in oxygen transport in blood & muscle, energy production, activation of enzymes that burn (oxidize) foods to produce energy & transport of fatty acids into the energy-producing mitochondria (fatty acids are the major energy source for muscles);

• Activates vitamin A; necessary for DNA, RNA, collagen & antibody synthesis;

• Stimulates immune function; iron regulates rate of T-cell production (DNA synthesis); involved in proteins that generate toxic oxygen & iodine to kill bacteria;

• Part of system which builds resistance to infection by yeasts, viruses & bacteria;

• Necessary in the synthesis of connective tissue (collagen & elastin);

• Involved in production & regulation of several brain neurotransmitters (serotonin, dopamine, noradrenalin) that play important roles in behaviour;

• Improves learning & behaviour; prevents learning disorders (emotional, social & cognitive), irritability & lack of interest in surroundings in children;

• Part of the system which detoxifies drugs; part of iron-containing enzymes: catalases, peroxidases & cytochromes;

**Quantities**

• **Measurement:** milligrams;

• **Optimum:** (SONA) average similar to DRI;

• **Minimum:** (DRI) male 8 mg/day; female 18mg/day (27 mg during pregnancy);

• **Less than RDA:** 60% of population, according to a U.S. government survey; 95% of children between 1 & 5 & females 18 to 44 years old;

• **Individual** optimum needs to be determined for each individual case; during childbearing years, women require about 2x as much iron as men — difficult to obtain even from carefully planned diets; vegetarians, pregnant women, athletes, the elderly & adolescents may also require iron supplementation; bleeding results in losses that need to be replaced;

• **Deficiency** from inadequate dietary supply (processed foods), blood loss from injury, internal bleeding, ulcers, menstruation (1 pint of blood contains 235 mg of iron); poor absorption due to lack of vitamin C in diet; vegan diet; drugs that make iron unavailable (tetracycline & its derivatives); diets high in substances that bind iron—phytic acid (grains) & oxalic acid (rhubarb, spinach & chocolate); diet high in phosphates; excess coffee or tea; - deficiency also associated with increased oesophagus & stomach cancer (Plummer-Vinson syndrome);
• **At risk:** infants, rapidly growing children & adolescents, females during reproductive years, pregnant women, people with injury or internal bleeding;

• **Symptoms include:** iron-deficiency anaemia (more common in women): fatigue, muscle weakness, light-headedness, anorexia, pallor, headache, sore tongue, mouth inflammation, difficulty swallowing, concave fingernails with length-wise ridges, cold hands & feet, lowered resistance to disease, palpitation during exertion; low blood haemoglobin measurement; irritability, apathy, poor digestion, confusion; lowered exercise tolerance; paleness of inner lower eyelid; susceptibility to colds;

• **Differentiate** between: B-6, B-12, folic acid, copper & zinc deficiency anemias; anemias due to lead poisoning, thyroid problems & lack of certain enzymes;

• **Toxicity:** iron overload from dietary intake is rare; repeated transfusions, thalassemia or genetic predispositions are usually required;

• 15 gram dose can be fatal for adult, 3 gram (3000 mg) dose for 2-year old;

• **Toxic symptoms** in children may begin at 20 mg/kg of body weight (keep iron supplements out of reach of children); slight excess can constipate;

• **Unbound iron** (ferrous) from tissue injury or genetic iron storage disorder (hemochromatosis, siderosis) damages heart, liver, pancreas & skin, generates destructive HO (hydroxyl) radicals & produces arthritic symptoms; adult long-term intake of more than 75 mg/day is usually necessary;

• **Reversed by:** lowering iron intake; increasing vitamin E intake; increasing bran, phytic acid, soy protein;

**Therapy with iron**

• Usual therapeutic dose is between 10 and 100 mg/day;

• Alleviates iron deficiency anaemia;

• Especially important to supplement the diets of women of childbearing age, pregnant women & breast-feeding mothers;

• Supplementation also important during early & adolescent periods of rapid growth;

• Important under conditions of extensive blood loss (surgery, accident, internal bleeding, blood donation);

• May improve athletic (esp. women) performance even if iron deficiency is not apparent (sub-clinical);

• Used to relieve symptoms of fatigue, that may be caused by low iron;

• May improve behaviour & learning disorders in children, adolescents & adults;

• Used to raise low haemoglobin;