# CALCIUM (Ca)

**General** - macronutrient element; the bone mineral;

- Most abundant body mineral, comprising over 1.5% of total body weight, about 1,200 grams (phosphorus content is about 680 grams);
- 99% of body's calcium is in bones & teeth; remaining 1% distributed in soft tissues;
- Calcium exchanged between bones, body fluids & soft tissues; adequate daily intake prevents calcium loss from bones (osteoporosis);

## Nutrition

- Sources: fish flour, cooked bones, collards, kale, other green leafy vegetables, dairy, tofu, canned sardines, salmon, tuna, hard water;
- Supplements: amino-acid chelates, bone meal, dolomite, calcium salts & acid salts, multi-mineral & multi-mineral-vitamin formulations;
- Absorption from duodenum & upper part of small intestine; children absorb up to 75%; adults absorb 30 - 50% under best conditions, 10 - 30% under normal conditions;
- Improved by: body's need for calcium; vitamin D (helps make carrier protein); acidity (decreases with age); presence of lactose, fructose & ribose; phosphorus;
- Antagonized by: oxalates (rhubarb, spinach); phytates (bran); dietary fat (forms insoluble calcium soaps); emotional instability; increased gut motility; lack of exercise;
- Storage: mainly in bones & teeth; 1% in extra-cellular fluids & soft tissues;
- Excretion: through urine & bile;
- Metabolism: regulated by magnesium concentrations; balance between calcium & magnesium is important to health; pregnancy, lactation & growth requires more calcium; high intake results in lower % absorption; lower intake gets higher % absorption;
- Interactions: calcium carbonates neutralize stomach HCl & require increased supply of this acid for absorption; high protein diet accelerates calcium loss;

## Functions of Calcium

- Involved in formation of bones: calcium phosphate + calcium hydroxide (hydroxyapatite) crystals in a matrix of collagen embedded in gelatinous substance (mucopolysaccharides);
- Involved in formation of teeth: middle layer (dentin) is like bone; outer layer (enamel) is denser hydroxyapatite crystals embedded in keratin; little change once formed; teeth contain 1% of body calcium;
- Calcium is required for muscle contraction;
- Essential for nerve conduction;
- Essential for blood clotting: calcium in injured tissue stimulates release of phospholipids (thromboplastin- tp) from injured platelets; tp catalyzes conversion of a normal blood constituent (prothrombin) to thrombin (Th); Th aids in changing another blood component (fibrinogen) to fibrin, that is the clot;

- Essential to heart beat;
- Involved in energy production;
- Required to maintain immune function;
- Regulates cell membrane permeability; regulates cellular activities (messenger molecule);
- Catalyst in many biochemical reactions: absorption of vitamin B- 12; activity of pancreatic lipase; secretion of insulin; formation & breakdown of neurotransmitter acetylcholine;

**Quantities**

- Measurement: in milligrams;
- Optimum: (SONA) average ranges not yet set;
- Individual optimum needs to be determined for each individual; calcium requirement increases
- with intake of protein, fat, alcohol, phosphorus (junk diets); smokers require increased amounts of calcium;
- Minimum: (DRI) set at 1000/1300 mg/day;
- Less than RDA: 68% of population, according to a U.S. government survey;
- Deficiency from inadequate intake; poor absorption; excess phosphorus; excess magnesium; deficiency of vitamin D or too little skin exposure to sunlight; excess dietary protein; overuse of antacids; transfusion of citrated blood; hypo-parathyroid; chronic kidney failure;
- High risk in elderly, users of aluminum-containing antacids, alcohol or cortisone; inactive people, those on low-calorie diets, those eating high protein diets & those on high fibre diets; milkintolerant people, pregnant women;
- Symptoms include: muscle cramping, bone & tooth malformation, anxiety, allergies, heart palpitations, insomnia irritability, seizures, loss of cognitive function, weak bones & teeth, stunted growth;
- In infants, rickets, described under vitamin D;
- Chronic mild deficiency may produce cataract; osteoporosis (10 -50% of people over 50), (higher incidence in women because women lose calcium 3x as fast as men); spontaneous bone fractures (80% in women); {osteoporosis also involves poor diet, poor absorption, poor utilization, parathyroid gland irregularity, failure to synthesize collagen matrix, immobility, loss of estrogens}; osteomalacia: lack of sunshine, anti-convulsive drugs, successive pregnancies & lactation;
- Severe deficiency: abnormal heartbeat, dementia, muscle spasms (tetany), convulsions;
- Toxicity: from acute renal failure, excess vitamin D (hypercalcaemia), too little phosphorus, lack of activity, immobilization, excess thyroid, excess parathyroid, tuberculosis, malignancies, beryllium & drugs including lithium, thiazides & others;
- Excess or deficiency of magnesium or imbalance in Ca-Mg ratio may form kidney stones, cause soft tissue calcification, produce magnesium deficiency & premenstrual syndrome;
- Prevented by: presence of magnesium in equal amounts;

## Therapy with Calcium

- Useful in treatment of osteoporosis;
- Important in pregnancy & lactation;
- May be helpful in PMS, with evening primrose oil, magnesium, zinc & vitamins B-3, B-6 & C;
- Helps ease “growing pains” of children & adolescents; may help relieve muscle cramps;
- May be required by vegans on diets high in vegetable protein;
- Female athletes & post-menopausal women require increased calcium (lower oestrogen);
- Useful for those intolerant to milk;
- Calcium protects against toxicity from lead (Pb);
- Along with vitamin D, calcium (1,250 mg/day) may prevent colon cancer (slows colon cell division, detoxifies bile acids);
- Useful for lowering blood pressure in some hypertensive individuals (1,500 mg/day); helps prevent cardiovascular disease; may lower high cholesterol in some individuals;
- Anecdotal reports of calcium use as natural tranquilizer, alleviation of cramps in legs of pregnant women & improved skin health (a calcium-dependent anti-oxidant enzyme is present in skin; calcium deficiency may speed skin ageing)
- Synergists: vitamins D and K; magnesium; phosphate; silicon; boron.