

VITAMIN C (Ascorbic Acid)

General - water-soluble; anti-scurvy factor;

- Saturated adult human body contains about 5,000 mg; 1,500 mg on 100 mg/day intake; lost at rate of 3% per day; signs of scurvy begin at 300 mg body content;
- Made by almost all plants; most animals make Vitamin C in liver or kidneys on need;
- Due to a mutation millions of years ago, humans & a few other species lack enzyme needed to convert glucose to vitamin C & depend on dietary sources;
- Scurvy prevented by less than 100 mg/day; need for optimum health fluctuates widely;
- Vitamin C dependency can be seen as “potentially fatal inborn (genetic) error in glucose metabolism” (genetic condition like albinism, sickle cell anaemia & haemophilia) requiring between 1,500 and 4,500 mg/day for other important functions in the body;
- 150 pounds (adult human weight) of rat, mouse, housefly, dog, squirrel, goat, cow, mountain lion, etc. make between 2,000 & 15,000 mg/day & 4 or 5 times that much during periods of injury, stress or prolonged physical activity;
- Diets recommended for captive monkeys provide 4,000 to 5,000 mg/day of ascorbic acid per 150 pounds of body weight; human should have similar requirements (cell biochemistry is similar);
- **History:** scurvy described by Hypocrites in 400 B.C.; limes to British sailors in 1747 prevents scurvy (“scourge of the navy”) deaths on sea voyages & “limeys” rule the seas for 200 years; structure identified in 1932; synthesized in 1934; world-wide attention in 1970;

Nutrition

- **Sources:** best: black currant, sweet pepper, parsley; good: cauliflower, potato, sweet potato, broccoli, Brussels sprout, strawberry, citrus, guava, mango, fresh vegetables, fresh fruit; C content increases with matured development of plant; adrenal glands of freshly killed animals;
- **Supplements:** acid, mineral salts & effervescent powders; tablet, timed release tablet; capsule, multi-vitamin & multi-mineral-vitamin formulations;
- **Absorption** from duodenum & small intestine, both passive diffusion & Na-dependent active transport; circulates freely; low concentrations (30 - 60 mg) 100% absorbed; absorption: 90 mg dose = 80%; 1,500 mg = 49%; 3,000 mg = 36%; 12,000 mg = 16%; unabsorbed vitamin C continues into bowel, draws water by osmotic effect & makes watery stools;
- **Improved by:** frequent small doses absorbed better than few large doses;
- **Antagonized by:** smoking, stress, high fever, antibiotics, cortisone, inhalation of DDT or petroleum fumes, aspirin;
- **Stability:** destroyed by heat, light & oxygen; destroyed by long storage (15% / month) & cooking (30 - 50%); 50% lost within 1 week of irradiation (potatoes); C loss from broccoli: microwaved = 15%; pressure cooked = 20%; steamed =

30%; boiled = 55%; destroyed by baking soda;

- **Storage:** throughout the body; highest (50x) concentration in adrenals; elevated (3 - 10x) in kidneys, lung, liver, placenta; also high in pituitary, white blood cells, brain, thymus & eye lens; muscles hold about 600 mg; foetal plasma is 2 - 4x higher than adult;
- **Excretion:** oxidized form excreted through kidneys within few hours after consumption; also lost through sweat;
- **Metabolism:** oxidized to dehydroascorbic acid; re-usable after being reduced to ascorbic acid again; excretion increased by sulpha drugs; increased C requirement in elevated serum copper (schizophrenia, stress, smoking, menstruation, the "pill", last months of pregnancy) or iron (injury);
- **Interactions:** aspirin, alcohol, analgesics, antidepressants, anticoagulants, oral contraceptives & steroids may decrease body's C levels; vitamin C is used up in detoxification of drugs; copper cooking utensils destroy C present in foods; C can give false reading on blood glucose tests;

Functions of vitamin C

- Required for synthesis of connective tissue substances chondroitin sulphate & collagen, that are structural & cementing materials of the body & give structure to muscle, vascular tissue, bone, cartilage & scar tissue;
- Necessary for wound healing; aids in forming red blood cells;
- Hydroxylates (OH addition) lysine to hydroxylysine & proline to hydroxyproline;
- Prevents capillary bleeding into intercellular spaces (gums, skin);
- Keeps bone matrix (mainly of collagen) capable of holding Ca & P for strong bones;
- Keeps cartilage (mainly collagen) able to hold bones in place at joints;
- Critical to certain time in dentin layer formation during tooth development;
- Antioxidant (reducing agent), protects vitamins B-1, B-2, folic acid, B-5, A & E from oxidative destruction; enhances immune system function; protects brain & spinal cord from damage by free radicals; many beneficial effects of vitamin C result from its antioxidant rather than its vitamin properties;
- Prevents harmless substances from being oxidized to carcinogenic state (e.g. nitrates to nitrites, to nitrosamines);
- Promotes synthesis of mucopolysaccharides, that inhibit growth of cancer cells;
- Ascorbic acid sulphate may provide sulphates for mucopolysaccharide synthesis; crosses bloodbrain barrier; mobilizes cholesterol from tissues for removal from body; lowers cholesterol;
- Protects against stress of surgery, radiation & chemotherapy (cancer treatment);
- Detoxifies histamine, relieves symptoms of niacin flush, hay fever, frostbite, poisoning;
- Necessary for synthesis of carnitine, transporter of fats into mitochondria, that "burn" fats to produce energy;

- Required to make neurotransmitters (tyrosine to noradrenaline, tryptophan to serotonin);
- Necessary for phenylalanine & tyrosine metabolism; indirectly involved in thyroid hormone production;
- Required to make peptide (protein) hormones which stimulate synthesis of pigment-producing hormone & adrenal steroid hormones;
- Required to convert cholesterol to bile acids; helps regulate blood fats;
- Catalyzes conversion of folic acid to its active form;
- Helps calcium absorption by preventing formation of insoluble calcium complex;
- Enhances absorption, storage & use of dietary iron; keeps iron in reduced (Fe⁺⁺ ferrous form); activates some iron-containing enzymes; improves iron absorption up to 400%;
- Synergists: vitamin E, beta carotene, B-complex (esp. B-6, B-12, folic acid, B-5), testosterone, somatotrophin & bioflavonoids;
- Antagonized by: alcohol, air pollutants, industrial toxins, heavy metals, tobacco smoke; aspirin, antidepressants, diuretics, indomethacin, prednisone, estrogens;

Quantities

- **Measurement:** milligrams;
- **Optimum:** (SONA) average ranges from 150 to 1,000 mg/day; maintenance of tissue saturation requires about 10,000 mg/day;
- **Individual** optimum must be determined for each individual; varies with age, life style, state of health or illness; normal "bowel tolerance" of 3,000 mg/day may increase 10 or 20x during infection & illness; ascorbic acid may increase urinary loss of water-soluble B-complex & minerals slightly;
- **Minimum:** (DRI) set at 90 mg/day;
- **Less than RDA:** 40% of population, according to U.S. government survey; almost 100% of population, according to Irwin Stone & Linus Pauling;
- **Deficiency** results from inadequate diet; inadequate absorption; increased need; increased metabolism; smoking (20 cigarettes/day requires 40% more C); increased loss;
- **At risk:** institutionalized elderly (95% deficient); chronically ill; long-term drug therapy; people on junk food diets; poor people; infants during fast growth (5 - 24 months); infants 6 months on cow's milk (not breast fed); people with cancer (75% deficient);
- **Symptoms** include: scurvy: sore, bleeding gums; loosening teeth; tender, aching joints; capillary degeneration accompanied by skin bruising (petechiae) & haemorrhaging; anaemia resulting from breakdown in collagen & chondroitin sulphate metabolism; gangrene & death if left untreated;
- **Sub-clinical deficiency** (sub-clinical scurvy) can manifest as bleeding of gums, impaired digestion, proneness to colds & infections, bruising, nosebleeds,

slow wound healing, mild anaemia, lowered disease resistance, premature ageing & wrinkling of skin, lassitude, fatigue, drowsiness, insomnia, feeling run down; short of breath, muscle cramps, aching bones, joints & muscles; loss of appetite;

- **Infant scurvy:** irritability, anorexia, growth failure, tenderness of hips, anaemia, delayed wound healing, drop in white blood count; onset rapid & untreated, can quickly result in death;
- **Toxicity:** non-toxic at 1.00x RDA, to levels approaching 3 kilograms/day for an adult; above upper limit (bowel tolerance) of body's need for vitamin C, diarrhoea results;
- **Reversed by** lowering dose;
- **Illness** requires more vitamin C than health & increases "bowel tolerance"; gradual increase in daily consumption avoids diarrhoea & mild gastric disturbances;
- **"Rebound scurvy"** from suddenly stopping large doses has not been confirmed;

Therapy with ascorbic acid

- 60 - 10,000 mg/day used routinely; 10,000 to 100,000 mg/day used in some conditions (some flu viruses, cancer);
- 300 mg/day or more speeds healing when taken before & after surgery & other injuries; speeds healing of skin grafts;
- Decreases pain & swelling of arthritis & frees joint movement; preserves integrity of intervertebral discs, preventing back problems;
- Enhances immunity; protects against cancers; stimulates interferon production; blocks formation of nitrosamines from protein preservatives (nitrates & nitrites);
- Increased intake protects against bladder cancer; relieves pain of cancer, preventing breakdown of natural endorphins;
- Protects against oesophageal, laryngeal, stomach, cervical & lung cancer development;
- Protects from some effects of smoking on health; eases withdrawal from drugs (heroin, barbiturates, methadone); reduces withdrawal symptoms during detox of alcoholics;
- High doses are effective against shingles (herpes zoster), herpes I & II & all viruses and bacteria against which it has been tried; tissue saturation kills dormant viruses hiding inside cells;
- Protects against oxygen starvation of cells (animals);
- High doses alleviate constipation; heals varicose veins & haemorrhoids;
- Lowers high serum cholesterol levels; prevents damage to inside of arteries & formation of atherosclerotic plaque; improves survival rate after heart attack (free radical damage control);
- Helps relieve gout; may help some aspects of diabetes; prevents cirrhosis of liver;

- Neutralizes chlorine, nitrates & chloramines in water supply;
- Appears to prevent cataracts;
- Helps overcome male sterility (sperm clumping);
- Enhances body's use of minerals, especially zinc, magnesium, copper & potassium;
- Prevents & heals inflammation: urethritis, colitis, pancreatitis, conjunctivitis & phlebitis;
- Effective in leukemia & rheumatic heart disease;
- Relieves eczema, canker sores & fever blisters;
- Large doses lower susceptibility, decrease severity & shorten duration of colds & flu;
- Decreases histamine release, alleviating asthma, hay fever, allergies, niacin flush;
- Prevents phosphate type kidney stones from forming;
- Helps decrease mental illness & improve mental functioning;
- Detoxifies lead, cadmium, mercury, iron, copper, arsenic, benzene, carbon monoxide, some pesticides & many other toxic substances & drugs; detoxifies insect, spider & snake bites; rabies; heals poison ivy & oak if taken internally + paste applied to skin;
- Helps heal burns & wounds; helps victims of shock from injury, electricity, lightning; protects against frostbite, effects of cold temperature; protects against prickly heat & heat stroke;
- Slows ageing (requirement for C increases with age);
- Doses of 5,000 mg/ day drastically reduce duration of whooping cough in children;
- Doses from 1,000 - 30,000 mg/day can help mental lassitude, confusion & depression;
- Mega-dose ascorbic acid, B-3 & high protein diet reduces psychotic episodes; depressive part of manic-depressive illness improved by C (combined with low vanadium);
- Higher blood levels of ascorbic acid correlate with higher IQ's; recommended during pregnancy;