

VITAMIN E (Tocopherol)

General - oil-soluble; anti-sterility factor; oil-soluble antioxidant;

- Vitamin E is the official designation for alpha tocopherol, a fat-soluble nutrient found in the diet in varying amounts. Until recently it was thought that alpha tocopherol was the most active tocopherol and as such only official vitamin E activity (IU) is given to alpha tocopherol.
- The term vitamin E is now used to refer to all tocol and trienal derivatives. The tocols are alpha, beta, delta and gamma tocopherol, and the trienals are alpha, beta, delta and gamma tocotrienol.
- Gamma tocopherol, a potent antioxidant of ozone and nitric oxide is now shown to be as important as alpha tocopherol. The National Academy of Sciences now suggests that vitamin E formulas contain both tocopherols and that gamma tocopherol be the predominant one.
- Tocotrienols have potent anti-oxidant activity, but their turnover rate in human tissues is rapid and therefore unlikely to provide more than transitory effect, and little benefit as a nutritional supplement.
- Vitamin E esters such as alpha tocopheryl acetate and alpha tocopheryl succinate are not anti-oxidants in that form and must first be enzymatically de-esterified in the gut to the biologically active tocopherols before they function in the human system. This is an inefficient process and and more than 50% of the ester may not be converted.
- **History:** “anti-sterility factor” described in 1911; isolated in 1936; identified in 1938; recognized as essential for humans in 1968; deficiency syndrome described in 1977;

Nutrition

- **Sources:** wheat germ, wheat germ oil, whole grain, unrefined vegetable oil, nuts, seeds, eggs, whole grains, green leafy vegetables;
- **Supplements:** “dry” E acetate or succinate, d-alpha tocopherol, gamma/alpha tocopherols, multi-vitamin, multi-mineral-vitamin formulations;
- **Absorption** from small intestine, along with fats; 40 to 60% is absorbed into lymph (in chylomicrons); remainder is discarded in feces;
- **Improved by:** edible fats & oils; by taking with a meal; vitamin C prevents its oxidation; vitamin A aids in transport; manganese & selenium;
- **Antagonized by:** salts & sugar/acid chelates of iron & copper (oxides, carbonates, gluconates, succinates, acetates, etc.); oxygen; rancid food oils; processed foods; mineral oil; oral contraceptives; freezing; oxidizing agents, ozone & nitrogen oxides;
- **Stability:** destroyed by light & oxygen; heat-stable in boiling, but destroyed during frying & deep frying; some lost in frozen storage; storage at room temperature may decrease vitamin E content of foods by up to 50% within 2 weeks; encapsulation protects vitamin E against destruction;
- **Storage:** largely in adipose tissue, liver & muscle; high concentrations also found in blood platelets, pituitary, adrenals, testes, ovaries;
- **Metabolism:** plasma levels drop to half within a few days when vitamin E is withdrawn from foods; frank deficiency may take several months to develop;

Functions of vitamin E

- Chief activity in all cells & tissues is anti-oxidant; prevents oxygen from destroying many other compounds, including vitamin A & C, unsaturated fatty acids & membranes (phospholipids); (Note: oxygen is vital to cell respiration, but will damage cells if antioxidants fail to keep it under control);

- Vital to digestion & metabolism of unsaturated fats; Protects cells from damaging pollutants, peroxides & free radicals formed from organic molecules during normal metabolic processes; protects lungs against air pollution;
- Protects membrane integrity of cells in circulatory, digestive, respiratory, excretory & nervous systems; protects vitamin A against destruction by free radicals;
- Stimulates development & tone of skeletal, heart & digestive tract muscles;
- Retards aging processes of cells; prolongs life of red blood cells;
- Vitamin E & C reduces the formation of nitrosamines (carcinogen) in bacon;
- Gamma tocopherol plays a critical role in the defence against cancer and cardiovascular disease by inhibiting the process of inflammation more effectively than alpha tocopherol.

Quantities

- **Measurement:** 1 mg d-alpha tocopherol = 1.49 International Units (IU);
- 1 mg dl-alpha tocopheryl acetate = 1 IU = 1 tocopherol equivalent (TE);
- **Optimum: (SONA)** average ranges from 70 to 800 IU; increases with amount of unsaturated fatty acids in diet; high intake of unsaturated fats increases the rate of oxidative destruction of vitamin E, which sacrifices itself to spare fat & membranes;
- **Individual** optimum must be determined for each individual;
- **Minimum: (DRI)** average is set at 15 mg (22 IU);
- **Less than RDA:** estimated at 20 - 40% of population, due to reliance on processed foods;
- **Deficiency from:** insufficient intake; poor absorption (inflammatory bowel disease, cystic fibrosis, premature birth); lack of fats in diet; mineral oil; iron & copper salts; injury & tissue destruction, which rapidly use up body's supplies; rancid oils; increased requirement (premature infants, pregnant & lactating women); - intake of vitamin E from foods has fallen 95% since 1900, due to removal during food processing; deficiency is widespread in un-supplemented diets;
- **Symptoms include:** formation of peroxides, dienes & free radicals within cells, formed by oxidation of membrane fats & of soluble factors in cell cytoplasm; rupture of cell membranes; destruction or irreparable damage to nearby cells by substances spilling from ruptured cells; damage transmitted to future generations of cells; shortened red blood cell life; production of age pigment spots (ceroid pigments; lipofuscin);
- First **clinical signs** of deficiency: ruptured red blood cells (haemolysis), followed by abnormal deposits of fat in heart & muscles, shrinkage of connective tissues &/or muscle degeneration;
- **Prolonged deficiency** impairs absorption of fat & fat soluble vitamins, can lead to degeneration of the testes in men; nephritis from kidney tubule blockage by dead cells; blockage of bile duct; chronic pancreatitis; chronic gastrointestinal disorders; thrombotic conditions of the cardiovascular system; infertility in men & women; progressive neuro-muscular disease in children & adults (nutritional muscular dystrophy); formation of age pigments (lipofuscin); vitamin E deficiency anaemia from oxidative destruction of red blood cells; premature infants especially at risk — haemolytic anaemia, intraventricular haemorrhage, retrolenticular fibroplasias that can lead to blindness;
- **Toxicity:** virtually impossible to overdose on vitamin E; 200 times RDA (up to 3,000 IU/day) is safe for most people;
- Very high intake may increase bleeding tendency in patients on anti-coagulant drugs;
- Extreme supplementation may increase blood pressure in some people; **hypertensive** individuals start with low quantities & increase by 100 IU/week;
- Persons with **rheumatic heart conditions** may have to limit vitamin E intake to 150 IU/day; supervision by nutritionally competent health care professional is recommended;

Therapy with vitamin E

- 100-1,600 IU/day is usual therapeutic range; up to 3,200 IU/day used in menopause;
- Corrects the foregoing deficiency conditions if degeneration of the tissue has not progressed to irreparable damage;
- Reverses nutritional muscular dystrophy;
- Protects brain & nerves, muscles, heart & arteries, glands & reproductive organs from oxidative damage throughout life;
- Russian athletes use up to 150 IU/2-hour training to spare oxygen & promote endurance;
- Improves varicose veins, inflamed veins with blood clots (thrombophlebitis) & intermittent claudication; soothes dry itchy skin; regulates menstrual flow; prevents & alleviates some migraine headaches; prevents miscarriages;
- Protects lungs from damage due to smog; retards aging; preventive against cancer & heart disease, as well as general degeneration;
- Up to 100 IU/day used in premature infants, to protect cell membranes in brain, nerves, heart & muscles from oxidative destruction; to prevent blindness & brain damage;
- Cystic fibrosis requires 400 IU/day or more because of poor absorption;
- Topical use as anti-inflammatory agent, in cosmetics, to heal wounds & to protect skin against UV & other damage; retards skin ageing;
- Gamma tocopherol may inhibit prostate cancer & lung cancer.

VITAMIN K (Methyl Napthoquinone)

General. oil-soluble; anti-haemorrhagic factor;

- **Vitamin K** - from the Danish word “koagulation”; its discovery was made by virtue of its role in blood coagulation; several natural forms;
- Synthetic, water-soluble forms used in conditions of impaired fat absorption;
- Yellow, oily pigment abundant in green leafy vegetables, soya beans, peas & tomatoes;
- Normally manufactured by intestinal bacteria; depends on good intestinal health & flora;
- **History:** discovered 1934; isolated from alfalfa in 1939;

Nutrition

- **Sources:** widely available; best: alfalfa; dark leafy vegetables, associated with chlorophyll (chloroplasts); 50% of vitamin K produced by bacteria in lower intestine;
- **Supplements:** alfalfa; medical injections;
- **Absorption** into lymphatics; requires fats & oils; 40 - 70% absorbed; requires bile & pancreatic secretions;
- **Improved by:** edible fats & oils; vitamins A, C & E;
- **Antagonized by:** administration of antibiotics; mineral oil laxatives; bile obstruction;
- **Stability:** heat & oxygen-stable; destroyed by light, acid, alkali, oxidizing agents, alcohol;
- **Storage:** exclusively in the liver;
- **Excretion:** in bile;
- **Metabolism:** rapidly used up;
- **Interactions:** anti-coagulants interfere with activity by oxidizing vitamin K; intestinal synthesis is reduced by aspirin, some antibiotics & sulphonamides;