



## Gamma Vitamin E

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When it was first discovered in 1932, vitamin E earned a reputation as the "anti-sterility" vitamin because it was shown to have this effect in rats; however, it did not turn out to have this effect in humans. In 1938, vitamin E's structure was elucidated, at which point researchers gave it the chemical name of tocopherol, after the Greek words tokos, meaning offspring, and Phero, meaning to bring forth. Vitamin E is actually a group of eight isomers including four tocopherols (alpha, beta, gamma and delta) and four corresponding tocotrienol isomers. Alpha tocopherol is the most common and the most potent form, and is usually what is referred to by "vitamin E."

Eight stereoisomers are possible with alpha-tocopherol. Seven of these are only found in the synthetic form. Synthetic vitamin E, historically known as d,l-alpha-tocopherol, is more accurately referred to as all rac-alpha-tocopherol. The natural stereoisomer of vitamin E, historically d-alpha-tocopherol, is more accurately RRR-alpha-tocopherol. It has been shown that natural vitamin E has a substantially greater bioavailability than synthetic vitamin E.

Commonly taken in doses of 200 IU/d, vitamin E's recommended daily intake amount is 30 IU/d. There are no known toxicities associated with vitamin E, and approximately 60 percent to 70 percent of the daily dose is excreted in the feces. Vitamin E can cause side effects, however, in people taking more than 1,000 IU/d, including headache, fatigue, nausea, double vision, muscular weakness and gastrointestinal distress. Symptoms of vitamin E deficiency include dry skin, dull dry hair, rupturing of red blood cells resulting in ane-

mia, easy bruising, PMS, fibrocystic breasts, hot flashes, eczema, psoriasis, cataracts, benign prostatic hyperplasia, poor wound healing, muscle weakness and sterility.

In the body, vitamin E is the most important fat-soluble antioxidant and ensures the stability and integrity of cellular tissues and membranes throughout the body by preventing free radical (lipid peroxidation) damage. Vitamin E is also known for decreasing platelet adhesion, protecting blood vessels against developing atherosclerotic lesions and preventing LDL-cholesterol from being oxidized. During heavy exercise, vitamin E markedly reduces the amount of exercise-induced free radical damage to the blood and tissues and helps reduce exercise induced muscle injury. The nutrient also helps protect against cataracts and macular degeneration, and it can enhance the immune system and support resistance to infection.

### CLINICAL APPLICATIONS:

### ALZHEIMER'S DISEASE:

While recent research has indicated intake of vitamin E in supplemental or dietary forms did not protect against the development of Alzheimer's disease (AD), oxidative stress is believed to be involved in the pathogenesis of the disease. Contrary to this study, several additional investigations have shown a protective effect of vitamin E.

The nutrient was shown to block neuronal death in vitro and may protect against the development of AD, as suggested by animal and human studies. Research involving Alzheimer's patients has shown antioxidant levels and activities (including those of vitamin E) are reduced in patients compared to healthy controls, and it has been suggested that supplementation with vitamin E should be considered for the pharmacotherapy of AD. A research review indicated while there is promising data for vitamin E in AD, confirmation is necessary. Vitamin E has also been shown to be protective

against AD when combined with other therapies, including vitamin C or the pharmaceutical donepezil.

**CANCER:** The different isomers of vitamin E may play a role in preventing cancer. Alpha-tocopherol was shown to have preventive effects against prostate cancer. A critical review on the potential role of alpha-tocopheryl succinate indicated the isomer—both singularly and combined with dietary micronutrients—is a useful complementary therapy for cancer because it increases tumor response and decreases the toxic effects of chemotherapy. Another isomer of vitamin E, gamma-tocopherol, was inversely associated with prostate cancer in a case-control study of 10,456 men."

Like the tocopherols, the tocotrienol isomers of vitamin E may also have a preventive effect against cancer growth. Specifically, gamma-tocotrienol and delta-tocotrienol (derived from Tocomin® palm tocotrienol complex, supplied by Carotech Inc., Edison, N.J.) may enhance the inhibitory effect of tamoxifen (standard breast cancer drug). Similarly, the tocotrienol-rich palm oil fraction (as Tocomin) seems to directly inhibit the growth of MCF-7 breast cancer cells. Additional research determined the tocotrienol-rich fraction of palm oil (as Tocomin) and its individual fractions (alpha, gamma and delta) inhibited the growth of another breast cancer cell line, ZR-75-1.

**CATARACTS:** Animal research has shown vitamin E supplementation significantly reduces induced cataract forma-

tion. In a human study, of 158 patients followed for three years, those taking vitamin E, as well as beta-carotene and vitamin C, demonstrated a small deceleration in the progression of age-related cataracts.

**DIABETES:** In subjects with Type II diabetes, there seems to be an imbalance between plasma oxidant and antioxidant systems. Specifically, vitamin E levels are known to be significantly lower in Type I and Type II diabetics compared to healthy controls and dietary alpha-tocopherol intake has been shown to be inversely and directly associated with fasting plasma glucose concentrations in women. Animal research has linked intake of a tocotrienol complex with a reduction in blood glucose. As for the complications of diabetes, vitamin E intake may be therapeutic against diabetic nephropathy, while topical application of the nutrient seems to improve skin microcirculation and decrease free radicals by almost half (45.3 percent) in diabetic microangiopathy."

**HEART HEALTH:** Vitamin E levels seem to affect the risk of cardiovascular disease. One study of 102 healthy elderly subjects indicated those with vitamin E levels in the highest quartile had one-sixth the risk of cardiovascular events compared to those in the lowest quartile. Another study of 310 women showed low vitamin E intake as a risk factor for early atherosclerosis. Vitamin E's protective effects on heart health may be due to its ability to reduce lipid peroxidation and LDL cholesterol oxidation!

While many studies use a single isomer of vitamin E (usually alpha-tocopherol), there is some evidence that additional isomers of vitamin E can improve heart health. Animal research has shown that while both alpha and gamma tocopherol impacted the parameters of oxidation and thrombogenesis, gamma-tocopherol was significantly more potent than alpha-tocopherol. A study of mixed tocotrienols showed these isomers protect heart health by reducing cholesterol levels, as well as the atherogenic apolipoprotein B and lipoprotein (a) plasma levels." Compared to alpha-tocopherol and alpha-tocopheryl succinate, alpha-tocotrienol was more effective in reducing adhesion molecule expression and monocytic cell adherence.

**OSTEOARTHRITIS:** It has been hypothesized that lipid peroxidation plays a role in cartilage aging and the pathogenesis of osteoarthritis (OA). An in vitro model demonstrated vitamin E's protective role against chondrocyte lipid peroxidation and collagen oxidation. Animal research indicated oxidation may be involved in the pathogenesis of OA, although a diet supplemented with vitamins, including E, as well as selenium, might be important in prevention. Despite these promising in vitro and animal studies, two human clinical trials have failed to show a therapeutic effect of vitamin E against OA.