USANA Technical Bulletin

Tocotrienols

Technical Background

- Vitamin E (d-alpha-tocopherol) is still generally regarded as the most important lipid-soluble antioxidant in the human system. Its protective effects involve the inhibition of lipid (fat) oxidation in the gut, blood stream, tissues, and cells. Specific activities include suppression of free radical formation, suppression of oxidative chain reactions, and repair of damaged cell constituents, particularly cell membranes.
- Tocotrienols are structurally and functionally similar to vitamin E and other tocopherols. Like the tocopherols, several forms of tocotrienols are known (alpha-, beta-, delta-, and gamma-tocotrienol).
- Tocotrienols have been shown to be potent antioxidants in their own right with *in vitro* biological efficacy rivaling or, in some cases, surpassing vitamin E.[1, 2, 3]
- Tocotrienols at doses as small as 42 mg/day have been found to reduce blood cholesterol levels by 5-35% in a number of different clinical trials.[4, 5, 6] Reductions of several other risk factors were also seen (ApoB 10%, thromboxane 25%, platelet factor 4 16% and glucose 12%).
- In tests involving subjects with hyperlipidemia and carotid stenosis who were fed high levels of α-tocopherol (96 mg/d) and mixed tocotrienols (240 mg/d) for 18 months, a third of the patients showed carotid atherosclerotic regression and only 8% showed progression. The placebo group showed no cases of regression and 40% of cases with progression of symptoms[7].
- In cell culture studies, tocotrienols were found to inhibit the growth of estrogen receptor-negative human breast cancer cells[8]. This activity was enhanced by the addition of Tamoxifen, a drug commonly used in breast cancer treatment[9].

Sources and Recommended Intake

- Rice bran oil and palm kernel oil contain approximately 0.1% tocotrienols. Other unrefined plant oils, such as soybean, corn, canola and sunlower, contain vitually no tocotrienols.
- Supplemental tocotrienols are obtained from refined fractions of either rice or palm oils in which the tocotrienols have been extracted and concentrated.

- No Recommended Dietary Allowance (RDA) for tocotrienols has been established. Commercial tocotrienol products typically supply 10 to 50 mg of mixed tocotrienols per day.
- Like vitamin E, tocotrienols are extremely safe. Human studies have shown no adverse effects with consumption of 240 mg/day for 18-24 months.[7, 10]

Abstracts

Suarna, C., Hood, R.I., Dean, R.T., Stocker, R., Comparative antioxidant activity of tocotrienols and other natural Lipid-soluble antioxidants in a homogeneous system, and in rat and human lipoproteins. Biochimica et Biophysica Acta, 1993; 1166: 163-170. The antioxidant activity of tocotrienols toward peroxyl radicals was compared with that of other natural lipid-soluble antioxidant in three different systems by measuring the temporal disappearance of antioxidants and the formation of lipid hydroperoxides. In homogeneous solution, the initial rates of consumption of the various antioxidants, assessed by competition experiments between pairs of antioxidants for radicals, decreased in the order: ubiquinol-10 ≈ ubiquinol-9 > α-tocopherol ≈ α-tocotrienol > β-carotene ≈ lycopene > γ-tocopherol ≈ γ–tocotrienol. Following in vitro incubation of human plasma with α-tocotrienol, this form of vitamin E was present in all classes of lipoproteins isolated from the supplemented plasma. Dietary supplementation of rats and humans with a tocotrienol-rich preparation resulted in a dose-dependent appearance of α- and γ–tocotrienols in plasma and all circulating lipoproteins, respectively. Exposure of such enriched rat plasma to aqueous peroxyl radicals resulted in simultaneous consumption of the α- and then γ–isomers of vitamin E. The sequence of radical-induced consumption of antioxidants in freshly isolated, in vitro and in vivo tocotrienol-enriched low density lipoprotein LDL was again ubiquinol-10 > α-tocotrienol ≈ α-tocopherol > carotenoids > γ-tocopherol ≈ γ–tocotrienol. Under conditions where radicals were generated at constant rates, the rate of lipid hydroperoxide formation in LDL was not constant. It proceeded in at least three stages separated by the phase of ubiquinol-10 consumption and, subsequently, that of α-tocopherol/α-tocotrienol. Our results show that dietary tocotrienols become incorporated into circulating human lipoproteins where they react with peroxyl radicals as efficiently as the corresponding tocopherol isomers.

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