Effects of Broad-Spectrum Antioxidant Supplementation on the Antioxidant Status of Human Plasma

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Atherosclerosis is believed to be an inflammatory disorder triggered in part by oxidative stress.[1] Free-radical injury to arterial endothelial cells and oxidative modification of LDL are both thought to contribute to the endothelial dysfunction that eventually leads to atherosclerosis. Epidemiological studies and human clinical trials support this view.

Diets rich in antioxidants, including vitamin C, vitamin E, and beta-carotene, have been linked to reduced risk of cardiovascular disease.[2,3] Use of vitamin E and vitamin C supplements has also been associated with reduced risk of heart disease, and while the results of clinical evaluations are mixed, at least one clinical trial involving patients at significant risk for heart disease showed some benefit from vitamin E supplementation.[4] The purpose of this clinical study was to evaluate the short-term effects of the USANA Essentials (a multivitamin and mineral supplement containing a broad spectrum of antioxidant ingredients) on the antioxidant status of human blood.

Methods

This double-blind, placebo-controlled clinical study involved 20 healthy male subjects between 25 and 55 years of age. Subjects were randomly assigned to one of two treatment groups: the USANA Essentials (three (3) Mega Antioxidant and three (3) Chelated Mineral tablets daily) or placebo. The clinical phase of the trial lasted seven days. During this period, subjects were instructed to refrain from using other vitamin supplements, alcohol, or drugs. They were further told to continue their normal dietary and exercise habits.

Blood samples were collected on Day 0 (baseline) and again on Day 7. Samples were processed and plasma fractions were analyzed. Beta-carotene, vitamin E, and vitamin C contents were determined by HPLC. Malondialdehyde and conjugated diene concentrations were measured spectrophotometrically. The water-soluble antioxidant activities of total plasma and plasma minus urate, and the antioxidant activity of a plasma lipid extract were measured by inhibition of photochemoluminescence. Susceptibility to oxidation of apolipoprotein B (an LDL protein) in whole plasma was determined by immunoassay.

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Results

Seven days of supplementation with the USANA Essentials (delivering 17,000 IU/d beta-carotene, 450 IU/d vitamin E as d-alpha tocopheryl succinate, and 1,350 mg/d vitamin C) resulted in significant increases in plasma concentrations of these antioxidants (Figure 1). Plasma beta-carotene increased 250%, from 0.50 mM at baseline to 1.77 mM, after seven days of supplementation. Plasma vitamin E content increased by 44% (from 26.4 mM to 38.1 mM), and vitamin C doubled from 20.7 mM to 41.4 mM. No significant changes in these parameters were seen in the placebo group.

No significant changes in plasma malondialdehyde and conjugated dienes (two markers of lipid peroxidation) were seen in either the treatment or placebo groups after seven days of supplementation (results not shown).

Three measures of plasma antioxidant activity responded to broad-spectrum antioxidant supplementation (Figure 2). Total non-urate water-soluble plasma antioxidant activity increased by 77% from baseline after one week of treatment, while the antioxidant activity of the lipid-soluble plasma fraction increased by 69% over baseline. Additionally, T_{lag} (a measure of reaction kinetics) for the oxidation of apolipoprotein B increased by 21% over baseline, indicating that these proteins were more resistant to oxidation following one week of supplementation. No significant changes in total water-soluble plasma antioxidant activity were observed within the treatment group, and no significant changes in any measures of plasma antioxidant status were observed in the placebo group.

Discussion

One week of supplementation with the USANA Essentials provided significant improvements in plasma antioxidant status. Plasma levels of beta-carotene, vitamin E, and vitamin C all rose significantly during the treatment period. Additionally, the USANA Essentials contain many other antioxidant ingredients (*e.g.* a bioflavonoid complex, coenzyme Q10, and alpha-lipoic acid), as well as several nutrients that support natural antioxidant defense mechanisms (*e.g.* glutathione, n-acetyl-L-cysteine and selenium). It is likely that levels of these compounds also increased in the plasma of subjects in the treatment group, although no additional measurements were attempted.

Nevertheless, total plasma antioxidant activity was measured in several ways, and significant increases were observed. Total non-urate water-soluble plasma antioxidant activity rose significantly, most likely in response to increased levels of plasma vitamin C and water-soluble bioflavonoids. Total water-soluble plasma antioxidant activity did not increase significantly; this was expected, in part, because uric acid accounts for over 90% of this activity and masks the more subtle contributions of other antioxidant compounds (given the method used). The antioxidant activity of total plasma lipids rose significantly, most likely reflecting increases in plasma vitamin E, beta-carotene, alpha-lipoic acid, and other lipid-soluble constituents. Finally, the resistance of apolipoprotein B to oxidation significantly increased as a result of one week of supplementation with the USANA Essentials. Since this assay was conducted on whole plasma, the observed increase likely reflects improvements in both water-soluble and lipid-soluble antioxidant fractions.

We conclude that the USANA Essentials provide significant and rapid improvements in the antioxidant status of human blood. Given current hypotheses concerning the role of oxidative stress in heart disease, it is reasonable to expect that such changes could contribute over the long-term to improved cardiovascular health.

Acknowledgments

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Figure 1

Increases in plasma vitamin C, beta-carotene, and vitamin E after one week of supplementation with the USANA Essentials.

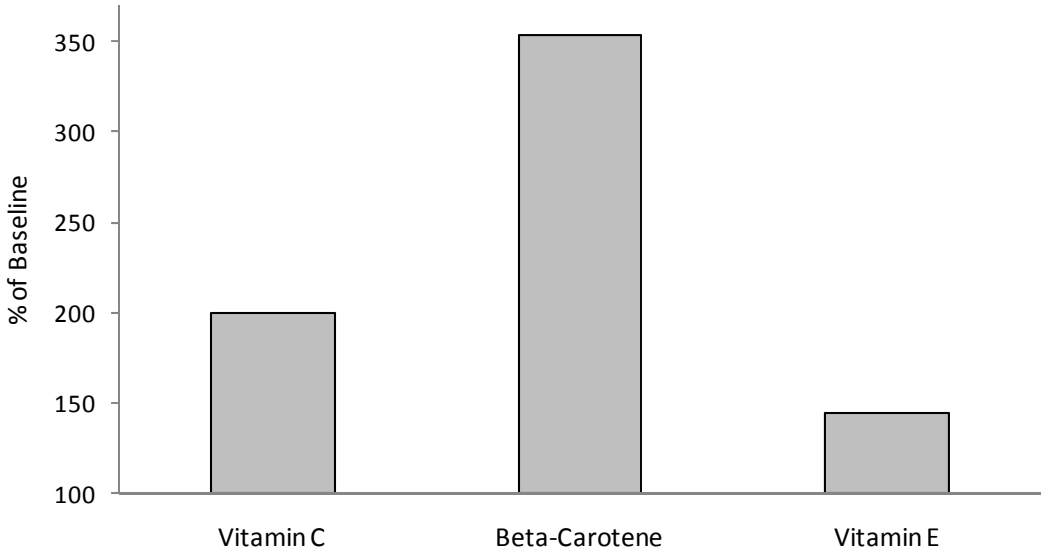
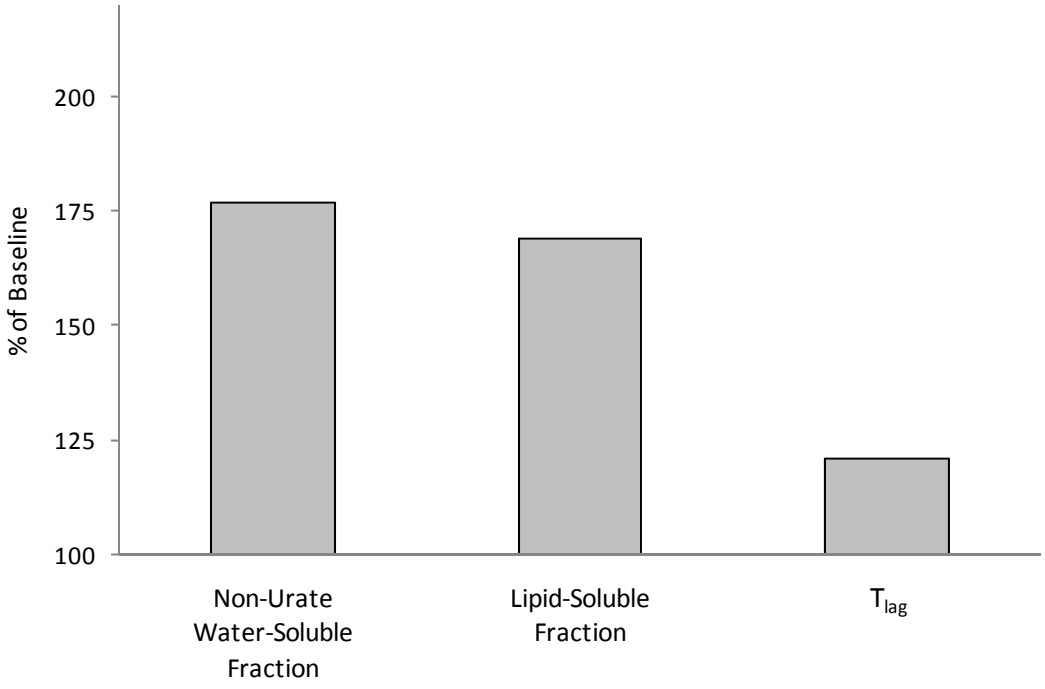


Figure 2

Increases in plasma antioxidant activity after one week of supplementation with the USANA Essentials.



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