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Effects of Antioxidant Supplementation on Oxidative Stress in Trained Cyclists

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Introduction

Strenuous physical exercise is thought to stimulate increased production of reactive oxygen species (ROS), as demonstrated by elevated markers of oxidative stress in the skeletal muscle, blood, and urine of athletes (1). Antioxidant supplementation has been shown to reduce levels of such markers, and as such, holds promise for limiting exercise-induced oxidative damage, reducing the rate of muscle fatigue, and hastening recovery from bouts of intense exercise (2). The purpose of this study was to investigate the effect of a full-spectrum antioxidant supplement on urinary markers of oxidative stress in trained cyclists.

Methods

Twenty-seven trained, male, amateur cyclists were recruited as subjects for the study (Table 1). Each subject performed a pre-supplementation test employing a submaximal exercise bout (one hour at 75% Watt peak) known to induce oxidative stress (3). Urine was collected prior to the test and again during a three-hour period, 9–12 hours following the test. Urine samples were analyzed to assess pre- and post-exercise changes in three urinary oxidative stress markers: malondialdehyde (MDA), 8-isoprostane (8-ISO), and 8-hydroxydeoxy-guanosine (8-OHdG). Blood samples were also drawn to determine plasma vitamin E levels. Subjects were then randomly assigned to one of three daily supplement regimes, in a double blind, placebo-controlled design. The three supplement regimes were as follows: placebo tablets containing no active ingredients (PLA); vitamin E (VIT E) as d-alpha tocopheryl succinate at 450 IU/d; and the USANA Essentials (USANA) delivering 450 IU/d vitamin E as d-alpha tocopheryl succinate, in addition to a full spectrum of other essential vitamins, antioxidants, and minerals. After four weeks of supplementation, all subjects were tested again using the same methods employed for the pre-supplementation test. Difference scores were computed across the four-week trial and analyzed using an ANOVA with LSD post hoc tests (α=0.05).

Table 1:

Subject characteristics (Mean ± SD)

	PLA (n = 8)	VIT E (n = 10)	USANA (n = 9)
Age (yr)	31 ± 6	32 ± 8	31 ± 6
Height (cm)	179 ± 11	179 ± 6	183 ± 7
Weight (kg)	76 ± 14	71 ± 6	79 ± 9
Weekly mileage	147 ± 63	147 ± 77	140 ± 63
VO_{2peak} (ml/kg/min)	61 ± 4	61 ± 8	58 ± 7
75% $Watt_{peak}$ (W)	249 ± 55	246 ± 33	260 ± 29

Results

Four weeks of antioxidant supplementation (VIT E and USANA) increased plasma vitamin E content by approximately 70% (Figure 1). No changes in plasma vitamin E pre- to post-supplementation were seen in the placebo group. Urine samples collected before and after the exercise bout at Week 4 of the trial showed significantly different responses in urinary MDA between treatment groups (Figure 2). Urinary MDA increased significantly in response to exercise in the placebo group. Subjects taking the vitamin E stand-alone supplement showed no change in MDA. Interestingly, MDA values for the subjects taking the multivitamin, antioxidant, and mineral supplement (USANA) significantly declined from pre- to post-exercise. Changes in urinary 8-ISO and 8-OHdG pre- to post-exercise were not statistically significant (results not shown).

Discussion

Results show that antioxidant supplementation significantly improved the plasma vitamin E status of subjects in both the vitamin E stand-alone and USANA groups. These individuals consumed 450 IU of vitamin E per day, and after four weeks, experienced 70% increases in plasma vitamin E. This result is consistent with the findings of other studies (4).

Results from this study further showed that, among the placebo group, intense exercise led to significant increases in urinary MDA, a marker of lipid peroxidation. Among the groups consuming antioxidants (VIT E and USANA), urinary MDA did not increase following the intense bout of exercise. In fact, in the group consuming the broad-spectrum vitamin, antioxidant, and mineral formula (USANA), urinary MDA showed a significant decline with exercise. These results suggest that antioxidant supplementation—in particular broad-spectrum antioxidant supplementation—may offer increased antioxidant capacity and protection when athletes are exposed to exercise-induced oxidative stress.

Levels of urinary 8-isoprostane and 8-hydroxy-deoxyguanosine did not respond to exercise or supplementation in this trial. Other studies have shown such responses. The intensity of exercise, duration of exercise, and/or the sampling protocol employed in this study may have been inappropriate for detecting such effects.

The finding that broad-spectrum antioxidant supplementation was associated with a significant pre- to post-exercise decline in urinary MDA is intriguing. Similar results were reported in another study involving antioxidant supplementation of cyclists (5). We believe that this result warrants further research.

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References

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Figure 1.

Plasma vitamin E content, pre- and post-supplementation, for the three treatment groups.

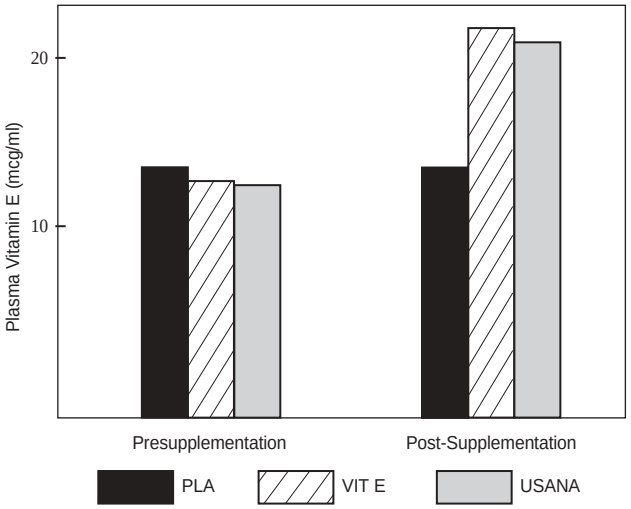

Figure 2.

Urinary MDA content, pre- and post-exercise, after four weeks of supplementation.