Nutritional Supplement in Male College Soccer Players: Effects on Performances and Oxidative Stress

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Abstract

High-level power-endurance are subjected to intense conditioning during preseason preparation in order to be able to sustain near-maximal efforts for extended periods. They often walk a fine-line between optimal training and overtraining in an attempt to maximize sport-specific fitness.

Purpose: To examine changes in performance capacity and oxidative stress responses in college soccer players over the course of a 21-day preseason preparation and to determine the impact of supplementing with a formula consisting of a proprietary antioxidant and nutraceutical blend containing superoxide dismutase (SOD), CoQ10, and beta glucans purported to reduce oxidative stress and enhance functioning.

Methods: Male Division 1 college soccer players (N=22) performed a progressive maximal treadmill test at the beginning and end of preseason in order to access changes in velocity at lactate threshold (Vlt) and at onset of blood lactate accumulation (V obla), time to exhaustion, and lipid hydroperoxide (LPO) response. The test consisted of 3-minute stages run at a constant 1% grade. Speed was increased by two km-h1 per stage until exhaustion. Blood lactate was sampled via capillary puncture at the end of each stage. Plasma concentration of LPO was accessed before and after each test. Following baseline testing, athletes were randomly assigned to receive the supplement blend (EXP n=12) or an isocaloric equivalent (CON n=10) daily for the duration of the preseason training.

Results: Repeated measures MANOVA revealed significant changes in performance capacity and oxidative stress markers over the preseason ($p<.001$). Follow-ups indicated that ΔV_{LT} (0.8+0.3 km-h^{1}, $p<.05$), ΔV_{OBLA} (1.1 +0.3 km-h^{-1}, $p<.01$), and Δtime to exhaustion (39.4 + 16.5 s, $p<.05$) were improved to across groups. There was a nearly significant group x time interaction with LPO response ($p<.07$). Examination of effect sizes (ES) and 95% CI indicated that EXP had a greater reduction in LPO responses during testing from preseason to end of preseason compared to CON (ES = -0.55). LPO responses were elevated in CON from pretest to posttest (ES = 0.78). EXP, when compared to CON, also appears to have a greater improvement to time until exhaustion. (ES = 0.39 and V_{LT} (ES = 0.30)

Practical Application: Preseason training in male college soccer players resulted in significant improvements in performance capacity, as indicated by improved V_{LT}, $V_{OLBA,}$ and time to exhaustion. In addition, though the short-term effects appear modest, supplementing the diet with a proprietary antioxidant/nutraceutical blend may enhance some of these effects, possibly by allowing for improved recovery.

Introduction

- Preseason training often places a high demand on athletes requiring them to engage in frequent high intensity workouts with limited time devoted to recovery, potentially leading to overreaching.
- Soccer players spend a considerable portion of a match at an intensity close to 75% of VO_{2max} and rely on anaerobic metabolism and power during brief burst of sprinting, kicking, and jumping (Bangsbo, 1994) – need to be able to perform near maximal capacity for extended periods, which may result in increased oxidative stress (Ji, 1993; Alessio, 1993)
- Lipid hydroperoxide (LPO) is often used as a plasma marker of peroxidation of polyunsaturated fatty acid in cell membranes due to reactions with reactive oxygen species (ROS) (Sjogin et al., 1990). Repeated peroxidation of cell membranes may decrease mitochondrial efficiency (Li et al, 1999).
- With exogenous supplementation of protected nutraceuticals, it may be possible to reduce acute and chronic oxidative stress and maximize gains form intense preseason training.
    - Superoxide Dismutase (SOD) in major antioxidant enzyme utilized by the body to defend tissues against free radical attack due to oxidative stress. SOD administration has been related to attenuated blood lactate concentration (lwama et al., 2002) and protects against oxidative stress-induced cell death (Vouldoukis et al., 2004).
    - Coenzyme Q10 (CoQ10) supplementation has been shown to aid mitochondrial functioning and protect against peroxidation of lipid membranes (Crestanello et al., 2002).
    - Oat beta-glucans have been found to reduce immunosuppression following intense exercise (Davis et al, 2004), which may impact recovery.
    - Resurgex™ (Millennium Biotechnologies Inc., Basking Ridge, NJ) was developed to address similar issues in patients suffering from muscle-wasting diseases.
    - It has been used as an adjunct to medical care in patients with HIV/AIDS, cancer, Hepatitis C, and other chronic illnesses but has received no direct testing on performance in high-level athletes despite the potential application as a nutritional aid.

- The purpose of this study was to examine changes in performance and oxidative stress in collegiate soccer players over the course of preseason preparation and to determine the impact of a supplemental proprietary nutraceutical blend proposed to reduce oxidative stress and enhance recovery.

Method

Participants

- **Members of the 2004 Rutgers University Men's Soccer Team (N=22) were recruited for this study.**

M_{age} = 19.5 + 3.5 yrs **M_{weight} = 74.8 + 1.5 kg**
M_{height} = 175.5 +1.5 cm **M_{VO2max} = 49.7 + 0.9 mL*kg^{1} * min^{1}**

Procedures

- Performance tests were administered at the beginning and end of preseason training (21 days) using a progressive maximal treadmill test protocol.
    - 3 minute stages; 1 min. rest intervals for capillary blood sampling; constant 1% grade; speed increased by 2 km-h^{1} per stage (starting at 8 km-h^{1}) until exhaustion.

Upon arriving at the lab, athletes rested in a supine position for 30 min.

- 10 mL venous blood samples were obtained using the vacutainer system (Bect on Dickinson, Rutherford, NJ) and sodium heparin coated tubes.
    - Resting blood lactate was also assessed using the portable Lactate Scout Lactate Analyzer (SensLab GmbH, Leipzig, Germany) via capillary sampling.
    - Testing was done at the same time of day at pre- and post-test for each athlete.
    - Lactate samples were collected immediately following each 3-minute exercise interval and test termination; Venous blood draw was repeated with the athlete in a supine position immediately following test rumination.
    - Athletes refrained from ingesting substances affecting normal physiological functioning (i.e., coffee, tea, nicotine, alcohol) 24-hours prior to each test.
    - Following the initial test at the beginning of the preseason, athletes were matched on VO_{2max} and randomly assigned to receive either Resurgex Plus ^{TM} (Millennium Biotechnologies Inc., Basking Ridge, NJ; Federal HCPCS Code B-4145) or an iscaloric equivalent.
        - EXP n = 12, CON n = 10
        - 400 calories; 50 g CHO, 13 g fat, 21 g PRO
        - Resurgex contains a proprietary blend of supplements, including: SOD (gliSODin; 500 U), CoQ10 (75 mg), beta glucans (100 mg), & BCAAs (1750 mg).

- The drinks were administered daily immediately following the morning practice and 1 hour prior to the evening training session for the duration of preseason training.

MEASURES

Lactate Threshold and Onset of Blood Lactate Accumulation

Capillary blood samples were taken from the fingertip at rest and at the end of each 3-minute stage in order to analyze blood lactate accumulation. The Lactate Scout (SensLab GmbH, Leipzig, Germany) was used to determine whole blood lactate content. The Lactate Scout has previously demonstrated a variation coefficient between 3 and 8%. Lactate concentration was plotted against treadmill speed in order to determine the velocity at which lactate threshold (V_{LT}) occurred. V_{LT} was determined using the D_{MAX} method (Cheng et al/. 1992). V_{OBLA} was defined as the velocity at which blood lactate concentration exceeded 4 $mM*L^{1}$ (Yoshida et al., 1987).

Time-to-Fatigue

Total time spent running for each test was determined and used to establish total time-to-fatigue for each participant.

Oxidative Stress

Pre- and post-test blood samples were obtained from an antecubital vein using the vacutainer system (Becket Division, Rutherford, NJ) and sodium heparin coated tubes at both the beginning and preseason and end-of-preseason with the athlete in a supine position. Samples were centrifuged at 3,500 rpm for 10 minutes, the plasma was extracted and placed into microvials, and then samples were stored at -80 degrees Celsius. Plasma LPO was determined with the PCA-FOX assay (Wolff, 1994) using the procedures outlined Nourooz-Zadeh et al. (1994) involving Catalase addition to reduce interference of H_20_2 . Samples were combined with the PCA-FOX assay reagent mixture (100uM xylenol orange, and 20uM ferrous ammonium sulfate in 110mM perchloric acid), incubated for 45 minutes, centrifuged, and the supernatant was read at 560nM on a Molecular Devices Spectramax 340 plate-reader.

RESULTS

- Repeated measures MANOVA revealed significant main effects for Time, Wilks = .32, $F(4,17) = 9.13$, $p < .001$ indicating changes in performance and oxidative stress markers across the groups over the preseason.
- Univariate follow-ups for the Time main effect revealed significant increases in all performance variables across groups over the course of the preseason:

- V_{LT} (0.8 + 0.3 km*h^{1}, p<.05; ES= .043)
- V_{OBLA} (1.1 + 0.3 km*h^{1}, p<.01, ES= 0.71)
- Time-to-Fatigue (39.4 + 16.5 s, p< .05; ES= 0.46)

- Follow-ups indicated a nearly significant (p<.07) group x time interaction for LPO.
- Examination of ES and 95% CI allowed determination of the magnitude of the changes over the course of a 21-day preseason.
    - Results suggested that the CON group had a significantly elevated LPO response from Test1 to Test2 (ES = .78), while the EXP group had a reduced LPO response (ES = -.40). The degree of change between the groups was significantly different (ES = -.55, p< .05).
    - EXP, when compared to CON, also appeared to have a greater improvement in time to exhaustion (ES = .39) and V (ES = 0.30).

DISCUSSION

- Preseason training in Male Division 1 college soccer players resulted in significant improvements in performance measurements, such as V_{LT} and $V_{OBLA,}$ and time-to-fatigue.
- It appears there may be some added benefit to performance when supplementing with Resurgex^{TM}.
    - The EXP group had a greater improvement in time-to-exhaustion and V_{LT}.
    - This performance may be by enhanced recovery via reduced oxidative stress in response to training – the EXP group had less elevation in LPO by the end of preseason training.
- The attenuated lipid peroxidation is consistent with other studies using high antioxidant diets (Rokitzki et al. 1994; Watson et al., 2005).
    - The reduced oxidative stress response is also consistent with previous findings for GliSODin^{TM} supplementation (eg. Muth et al, 2004; Vouldoukis et al., 2004) During the course of an intense preseason training regimen, this effect may allow for improved recovery and enhanced mitochondrial functioning.
    - This may be more pronounced with longer periods of supplementation or even more intense activity.
- There appears to be considerable inter-individual variability in response.
- Though the effects of short-term supplementation with Resurgex ^{TM} appear modest, these may be meaningful effects for athletes of this level (and higher) warrant further, long-term investigation into the performance and biochemical adaptations that may occur.

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