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Oxidative stress in handball players: effect of supplementation with a red orange extract

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Abstract

Intense physical exercise represents a condition that is often associated with increased production of reactive oxygen species and free radicals in various tissues; supplementation of antioxidants may be desirable to reduce oxidative stress and provide a larger protective margin against its possible consequences. The aim of the present study was to evaluate, in a group of professional handball players, the effects of short-term dietary supplementation with a standardized red orange extract (containing anthocyanins, flavanones, hydroxycinnamic acids, and ascorbic acid; Red Orange Complex [ROC]) on some noninvasive biomarkers of oxidative stress. Eighteen professional handball players and 17 healthy volunteers were enrolled in this study. The supplementation consisted of 50 mg ROC per capsule in micronized form; all subjects were recommended to take 1 capsule twice a day for 2 months. The end points of oxidative stress taken in consideration were the serum total antioxidant status, the serum level of thiol groups, lipid hydroperoxides and malondialdehyde, and the frequency of spontaneous sister chromatide exchanges in peripheral lymphocytes. The results obtained clearly reflect an overall lower level of oxidative stress in the athletes examined after short-term dietary supplementation with the ROC. Dietary supplementation with the ROC (which is endowed with strong antioxidant capacity) is able to decrease oxidative

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stress and thus might protect against its short- and long-term health consequences in athletes engaged in regular training programs.

Keywords: Red oranges; Cyanidin-3-*O*-glucoside; Antioxidants; Exercise; Human; Dietary supplementation

1. Introduction

Intense physical exercise represents a condition that is often associated with increased production of reactive oxygen species (ROS) and free radicals in various tissues [1,2]. Physical activity increases the generation of free radicals in several ways, including increased cellular oxidative phosphorylation, catecholamine release, prostanoid metabolism, metmyoglobin release from damaged muscle, and radical release from macrophages recruited to repair damaged tissue [3,4].

To prevent oxidative stress, the body contains a large number of enzymatic and nonenzymatic antioxidants that either prevent ROS formation or scavenge radical species. Exercise can produce an imbalance between ROS and antioxidants, which is referred to as oxidative stress. Oxidative stress can lead to damage or destruction of tissue and cell macromolecules, such as lipids, proteins, and nucleic acids. Therefore, oxidative stress has been associated with decreased physical performance, muscular fatigue, muscle damage, and overtraining. Although there is no conclusive evidence that this affects sporting performance in the short term, exercise-induced oxidative stress may have longer-term health consequences.

Because the endogenous amount of antioxidants may not be sufficient to prevent exercise-induced oxidative stress [5], supplementation of antioxidants may be desirable to reduce oxidative stress and provide a larger protective margin against its possible consequences [6,7]. In fact, antioxidant supplements are marketed for and used by athletes as a means to counteract the oxidative stress of exercise. However, the results of studies that investigate whether antioxidant supplementation reduces exercise-induced oxidative stress are not consistent, perhaps because of the differences in the types and timing of the supplement, in the kinds and intensity of the exercises, and in the outcome measures.

Today, much evidence shows that diet supplementation with plant biophenols may be a successful strategy to decrease the risk of pathologic conditions related to free radical overproduction and/or to prevent their complications. In fact, plant-derived biophenols, such as flavonoids and hydroxycinnamic acids, have been shown to possess several biologic properties, many of which may be related, partially at least, to their free radical–scavenging, metal-chelating, and enzyme-inhibiting ability [8,9]. Particularly, cyanidin and its glycosides are considered dietary compounds with a potential beneficial role for human health [10] and are excellent free radical scavengers and metal chelators [11,12].

The Red Orange Complex (ROC) is a standardized red orange extract, obtained from three red orange varieties (*Citrus sinensis* var Moro, Tarocco, and Sanguinello) and has recently been proposed as a new antioxidant food supplement. The main active principles of the ROC are phenolic compounds (anthocyanins, flavanones, and hydroxycinnamic acids) and ascorbic acid, the antioxidant activity of which are well recognized [9,13-15]; in the fresh fruit, these