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EFFECTS OF L-ASCORBIC ACID AND ALPHA-TOCOPHEROL ON BIOCHEMICAL PARAMETERS OF SWIMMING-INDUCED OXIDATIVE STRESS IN SERUM OF GUINEA PIGS

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Abstract

Background: The purpose of this study is to determine the effect of L-ascorbic acid and alpha-tocopherol as well as combination of these vitamins with or without exposure to physical exercise on intensity of lipid peroxidation, activity of xanthine oxidase, activity of total antioxidative system, concentration of glutathione, and activity of catalase in the serum of guinea pigs.
Materials and Methods: The experimental measurements of intensity of lipid peroxidation, activity of xanthine oxidase, activity of total antioxidative system, concentration of glutathione, and activity of catalase were done in the serum of guinea pigs. The animals were exposed to the test load to achieve exhaustion and the test was terminated when the animal for the third time to sink into the water.
Results: The results of this study demonstrated that endurance exercise of guinea pigs induced oxidative stress response in terms of increased lipid peroxidation and activity of xanthine oxidase in the serum of experimental animals. Our study investigated the antioxidant activity of L-ascorbic acid and alpha-tocopherol also measuring three protective markers in the serum: total antioxidant activity, content of glutathione and activity of catalase. The results obtained show that the vitamins influence the concentrations of above mentioned biochemical parameters, which points out their protective effect of swimming-induced oxidative stress.
Conclusion: Single or combined administration of L-ascorbic acid and alpha-tocopherol caused significant inhibition of these markers indicating the important antioxidant activity of the vitamins. Results lead to conclude that the combined treatments with vitamins with or without exposure to physical exercise showed the clear synergistic effect.

Key words: L-ascorbic acid, alpha-tocopherol, guinea pigs, oxidative stress, biochemical parameters

Introduction

The term oxidative stress was first defined in 1985 as "a disturbance in the pro-oxidant-antioxidant balance in favor of the former" (Sies, 1985; Sies at al., 1985). Dean Jones has proposed that the term "oxidative stress" should be redefined as "a disruption of redox signaling and control" and this definition is gaining widespread acceptance (Jones, 2006). Practically, under physiological conditions (endogenous sources) as well as under some adverse events (exogenous sources), in biological systems there is continuous production of free radicals i.e, ions, molecules and compounds that have unpaired electron and are highly reactive with biological molecules (Halliwell and Gutteridge, 1999). As a result of their reaction with lipids, proteins or DNA, oxidized products are made (Halliwell and Whiteman, 2004). Cells are equipped with enzymatic and nonenzymatic antioxidant system to eliminate free radicals and to maintain redox homeostasis (Valko et al., 2007). In oxidative stress assessment, instead of measuring free radicals themselves (which have very short half-life) we can rely on measurement of products of biological damage as well as on measurement of antioxidative capacity (enzymatic and nonenzymatic components). Vitamin C and Vitamin E play pivotal role in cellular protection against reactive oxygen species (Halliwell and Whiteman, 2004).

Vitamin E (alpha-tocopherol) as a low-molecular-weight agent is the primary chain-breaking lipid-soluble antioxidant located primarily in the membranes of tissues and it is capable of scavenging reactive oxygen species (Janero, 1991; Packer, 1991). Ascorbic acid (vitamin C) is found in two chemical forms, as reduced (L-ascorbic acid, and its ionized form of L-ascorbate) and oxidized form as (L-dehydroascorbic acid; and its ionized form of L-dehydroascorbate). Ascorbic acid is hydrophilic compound and functions better in an aqueous environment. The ascorbate anion is the predominant form existing at physiological pH (pKa of ascorbic acid is 4.25) (Powers and Jackson, 2008; Yu, 1994). The most striking chemical activity of ascorbic acid is its ability to act as a reducing agent, implicated in detoxifying various oxygen radicals *in vivo*. The speed of conversion of ascorbic acid into dehydroascorbic acid in aerobic conditions is facilitated by the higher pH values, compared to the acidic environment (Carr and Frei, 1999). Mechanism of antioxidant activity involves the conversion of ascorbic acid into its oxidized form (dehydro-ascorbic acid) by donating two electrons to reactive oxygen species (Fischer et al., 2004). Ascorbic acid can act directly scavenging lipid hydroperoxide, superoxide and hydroxyl radicals or, indirectly, playing an important role in recycling of tocopherol, a process that results in the conversion of ascorbic acid into semiascorbyl radical (Packer at al., 1979). Some authors have shown the influence of physical exercise on oxidative stress and changes in sleep pattern (Esteves et al., 2014).

The aim of this work was to study the effect of L-ascorbic acid and alpha-tocopherol on some biochemical parameters of oxidative stress in the serum of guinea pigs as no previous study known to us investigated their effects on the experimental model exploited in our research. We hypothesized that the combination of two vitamins would achieve significant synergistic effects in the terms of oxidative protection.