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The Effect of the Training to the Levels of Selenium and Chromium in Blood

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ABSTRACT

The purpose of this study is to investigate the levels of selenium and chromium in blood in well-trained male rowers of Turkish national team during and after an aerobic maximal exercise. Eleven well-trained young male completed the exercise protocol. Blood samples were collected before the exercise, immediately after exercise, and one hour after the exercise. Blood was analyzed for Se and Cr by using inductively coupled plasma optical emission spectrometry (ICP-OES) method. Although there were no statistically differences between the pre and post Cr levels ($P > 0.05$), the levels observed one hour after the exercise showed statistically significant changes compared to the pre and post exercise values ($P < 0.05$). There was no change of statistical relevance in Se levels ($P > 0.05$).

Keywords: *ICP-OES, aerobic exercise, Se, Cr, rowers, training.*

1. INTRODUCTION

Chromium is an essential nutrient that potentiates insulin action and thus influences carbohydrate, lipid and protein metabolism. However, the nature of the relationship between chromium and insulin function has not been defined. Mertz et al. [1] suggested that the biologically active form of chromium (glucose tolerance factor) is a complex of chromium, nicotinic acid and possibly the amino acids glycine, cysteine and glutamic acid. Recent observations suggest that chromium needs may be increased by endurance exercise. Serum chromium concentrations in male runners increased immediately

after a 10 km (6.2 mile) run at peak intensity and remained elevated 2 h after completion of the run [2]. Also, daily urinary chromium output of runners was higher on the day of the run than on the days before and after the run [3]. Endurance activity may influence Cr status negatively and enhance urinary Cr excretion due to a complexing of Cr with lactate and an increase in plasma cortisol [4]. However, similar Plasma-Cr concentrations have been reported in athletes and untrained controls [5]. Chromium has been advertised for strength-type athletes, but also could be theorized to enhance aerobic endurance performance. Some researchers suggest an increase in lean body mass and decreased body fat with chromium

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picolinate supplementation [6]. Chromium supplementation has also shown no beneficial effects on sports performance. Walker and others [7], in a study with highly trained wrestlers, reported no ergogenic effects of chromium picolinate on neuromuscular or metabolic performance, while Livolsi and others [8], using well-trained female softball players, reported no significant ergogenic effect of chromium picolinate supplementation on muscular strength [9].

Selenium is an essential nutrient trace element because of its defence against oxidative stress, regulation of thyroid hormone action, and regulation of the redox status of vitamin C and other molecules [10]. Selenium is a component of the active site glutathione-peroxidase and, therefore, participates in the sequence of antioxidant mechanisms counteracting to lipoperoxidative damage [11,12]. In humans, serum selenium is associated with three types of proteins; selenoproteins (52%), extracellular glutathione peroxidase (39%), and selenomethionine (binding albumin) (9%) [13,14].

Exhaustive physical exercise is known to induce oxidative stress in animals, probably leading to oxidative damage in several tissues, including muscle, liver, heart, and lung tissues. However, a series of defense mechanisms, such as superoxide dismutase, glutathione peroxidase (GPx), and other endogenous antioxidants, protect the cell against these toxic oxygen metabolites [15]. Endurance training may induce heterogeneous effects on oxidative and antioxidant adaptation independently of Se supplementation [16]. However; athletes are generally not affected by Se deficiencies [17]. Selenium supplementation could prevent peroxidation of the muscle cell substructures involved in oxygen metabolism, possibly enhancing aerobic exercise performance. Although antioxidant supplements have not universally been shown to prevent lipid peroxidation, some studies with selenium supplementation have shown an enhancement of GPx status and reduced lipid peroxidation in prolonged aerobic exercise; however, in these studies, actual endurance performance did not improve [18].

In this study, blood levels of Cr and Se before, immediately after, and one hour after aerobic (75%) maximal endurance exercise were investigated in elite rowers.

2. EXPERIMENTAL

Subjects:

Eleven male subjects who are the members of Turkish National Rowing Team participated in this study. The median age of the participating subjects was 20.09 ± 1.45

(year) ranging from 19 to 22. The other physical characteristics of the subjects were as follows (mean \pm SD): weight (Kg) 67.09 ± 5.99 (range 58-77), height (cm) 175.91 ± 5.82 (range 167-187).

Exercise protocol:

A 2000 meter rowing ergometer test protocol was used to perform aerobic (75%) maximal endurance exercise. Exercise tests were performed on a Concept IIC rowing ergometer (Morrisville, USA). Subjects completed a 10-minute warm-up before the exercise. All subjects were asked to cover a distance of 2000 m in the least time possible. The test was performed at ambient temperature (21 ± 0.5 degrees of Celsius). This exercise protocol has been practiced by Dr. Muhsin Hazar.

Preparation of samples and measurement method:

Blood samples were drawn from the antecubital vein of the subjects right before, immediately after, and one hour after exercise.

On the 1 mL blood samples was added 2.0 mL HNO_3 and the samples were digested in Berghof / Microwave Digestion system MWS-3 microwave apparatus. The microwave were kept at 160°C for five minutes and at 190°C , 100°C and 80°C for ten minutes each. The totally digested samples were diluted to 10 mL with the addition of deionized water $18.3 \text{ megaohm cm}^{-1}$. Chromium was analyzed directly while selenium was converted to its hydride form before the analysis. For this purpose 1mL of blood sample was taken and 1 mL of 10% HCl solution was added to it. The mixture was kept at 90°C for 20 minutes and analyzed after it cooled down. All the analyses were performed with Perkin Elmer Optima 5300 DV model ICP-OES. DV, USA).

Statistical analysis:

Statistical analysis was performed with SPSS Ver. 15.0 for Windows. Statistical significance was set at $P < 0.05$ (with %95 confidence levels). Data are expressed as mean \pm SD. The data were first subjected to non parametric One-Sample Kolmogorov-Smirnov Test. Since $P > 0.05$ non parametric test deemed unnecessary and all the data was treated with Paired Samples Test (t-test).

3. RESULTS AND DISCUSSION

Before training, immediately after training and after one hour training maximal loading (aerobic) in blood Cr levels respectively were found to be $6.55 \pm 1.08 \text{ }\mu\text{g/L}$, $7.27 \pm 1.93 \text{ }\mu\text{g/L}$ and $9.04 \pm 1.42 \text{ }\mu\text{g/L}$ (Table 1). These values for Se were respectively $320.81 \pm 76.91 \text{ }\mu\text{g/L}$, $305.89 \pm 66.48 \text{ }\mu\text{g/L}$ and $275.98 \pm 57.66 \text{ }\mu\text{g/L}$ (Table 1).

Table 1. Blood Se and Cr levels before after and one hour after the maximal effort aerobic exercise

Variables	N	(\bar{X}) mean ($\mu\text{g L}^{-1}$)	Standard deviation
Cr	Before training	11	6.55
	After training	11	7.27
	One hour after training	11	9.04
Se	Before training	11	320.81
	After training	11	305.89
	One hour after training	11	275.98

No significant change was observed in blood Cr level between pre and post exercise values ($P > 0.05$) and the levels observed one hour after the exercise showed statistically significant changes compared to the pre and post exercise values ($P < 0.05$). However, there was no change of statistical relevance in Se levels ($P > 0.05$) (Table 2).

Table 2. P values between pre and post exercise, pre and one hour after the exercise and post and one hour after the exercise blood Cr and Se levels

Metals	Test group	P
Cr	Pre exercise-post exercise	0.294
	Pre exercise-one hour after the exercise	0.001
	Post exercise-one hour after the exercise	0.038
Se	Pre exercise-post exercise	0.538
	Pre exercise-one hour after the exercise	0.133
	Post exercise-one hour after the exercise	0.348

In a study among runners who were fed a controlled diet containing 2.1 ng Cr/MJ (9 g/1000 kcal), basal urinary chromium losses was significantly less than those observed in nonexercising men fed the same diet [21]. This finding suggests that either chronic exercise is associated with a partial depletion of body chromium stores, or it results in a redistribution of chromium that is manifested by conservation of chromium by the body. In endurance-trained rats fed rat feed with a chromium content of 2 mg/kg, the chromium concentration in the heart and kidney was increased significantly, but gastronomic chromium concentration was not affected [3, 22].

Selenium is a component of several enzymes, particularly glutathione peroxidase (GPx), an important cellular antioxidant enzyme. During physical activity, the oxidative stress due to excessive oxygen consumption is compensated by higher levels of free radical scavengers and by an increase in the activities of antioxidant enzymes to preserve the structure and functions of lipids,

DNA and proteins [23, 24].

In this study it was observed that there is no difference in Cr levels pre and after the exercise but one hour after the exercise significantly changes has been observed. It is reported in literature that the glucose level increases and insulin level decreases during exercise due to increased energy demand but the insulin level is unaffected from the exercise in well trained people [19]. It was concluded that fatty acids are used as energy source in these people and glycogen storage remains intact. This may be the reason for unchanged chromium levels. Anderson et al claimed that the glucagon level in blood increases but insulin secretion and therefore chromium level remain constant [20]. There may be an increase in insulin in order to regulate the increase blood glucose levels and this may cause an increase in blood Cr levels during post exercise recovery period.

There was no significant change in blood Se level and it may be caused by sportsmen took enough amount of Se in their daily diet. Se level changes with the level of the

exercise [14] and using a maximal endurance exercise may be another reason for it. There are also studies in literature reporting that Se has no effect on endurance exercises [25]. Rokitzki et al reported that there was not a significant change in pre and post training Se levels of erythrocytes [26].

Therefore the results obtained in this study are in good accordance with literature.

4. CONCLUSIONS

There was no statistical difference between the pre and post 2000m maximal effort rowing exercise blood Cr levels. However, the value observed one hour after the exercise differed significantly from both the pre and post values. On the other hand Se levels showed no statistical difference. These results indicated that the elite rowers have adequate Cr and Se reserves and there is no need for outside supplementation of these metals.

CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

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