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CHANGES AT NANO SCALE LEVEL IN COPPER AFTER AN AEROBIC ACTIVITY IN MALES

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The purpose of this research is the study of mineral element alternation of blood serum copper (CU) in athlete students. The alteration of students' serum copper is measured according to the scale of nano gram per micro liter (n gr/mic L). For this purpose, fourteen male subjects participated in this research. The subjects performed Bruce protocol aerobic exercise on treadmill machine up to exhaustion. Then the blood sample was taken from the elbow vein for three times. The first stage of blood taking was performed in a fasting state and also before exercise; the second stage was performed after doing exhausting aerobic exercise, and in the third one a complete day for resting was given to the subjects and then blood samples were taken. The blood samples were transferred to the pathological lab and were analyzed. The research result indicated that there is no significant difference in the serum copper concentration, between the first and the second stages ($p = 0.523$), between the first and the third stage ($p = 0.930$) and also between the second stage and the 24-hour rest of subjects ($p = 0.592$). The results of research indicated that, the exhausting exercises could not have any effect on homeostasis of copper mineral element and eventually on nutrient metabolism even in the scale of nano gram per micro liter.

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1. Introduction

Most of the elements play a role in the physiological events in the organism [1]. Especially elements like zinc (Zn) and copper (CU) have functions in carbohydrate, protein, and lipid metabolism [1]. Cu is a component of antioxidant enzymes that acts to protect the organism against the action of free radicals, especially in cardiovascular diseases. An imbalance in the metabolism of Cu might trigger hypercholesterolemia and disorders in oxidative stress [2].

The metabolism of trace elements is affected by many factors, including aging and exercise status. The majority of human and animal studies revealed that the Zn, Mg, and Cu levels exhibited a tendency to decrease by age in serum [3, 4], and different tissues [5, 6]. Meanwhile, the effect of acute and/or chronic exercise on trace element levels has been investigated in many studies. The trained status reached by regular physical activity induces an alteration in the body mineral homeostasis [7, 8].

Studies that have examined acute effects of strenuous exercise on copper status have shown varied results [9, 10]. For example, plasma copper concentrations fall after treadmill exercise in human volunteers [11]. In contrast, women performing a marathon run have increased plasma copper with no change in erythrocyte copper contents [12]. In a different study, a marathon run induces a small increase in plasma copper concentration, but, at the same time, produces a decrease in total blood cell copper concentration [10]. Other aerobic exercises in humans, as well as swimming to exhaustion by rats, increases serum or plasma copper concentrations [9, 13]. On the other hand, highly variable responses of plasma copper are seen following cycle ergometer exertion in human volunteers [14]. Finally, some forms of aerobic exercise are reported to increase urinary copper losses [15].

2. Methodology

In this research, the effect of aerobic exercise on blood serum copper alteration was studied. Aerobic exercise was performed on treadmill, using Bruce protocol. Fourteen athletic students participated in this research. Mean and standard deviation of participants' height, weight, and age were respectively registered as: (172.03 ± 1.22), (72.34 ± 3.22), (21.44 ± 22.12) table 1.

Subjects attended the lab at 8 o'clock in a fasting state. At the first stage, blood sample in 5 cc quantity was taken from each of them. Each subject was placed on the treadmill in turn and performed the Bruce exercise protocol up to exhaustion. Bruce test is used for examining the level of physical fitness and cardiovascular test. This test starts on the treadmill machine with initial speed of 1.7 mile per hours and a slope of 10 grades. In every 3 minutes, 2 grades are added to the machine steepness. In every 3 minutes, the speed of the machine is increased to 2.5, 3.4, 4.2, 5.0, 5.5, 6.0, 6.5, and 7 miles per hour respectively. So by this method the quantity of the subjects' Oxygen Consumption (vo_2 max) was measured to determine the level of their physical fitness. Immediately after Bruce protocol performance, again 5cc blood sample was taken. Twenty four hours of rest was given to the subjects. After that, for the third stage 5 cc blood was taken in the lab. Blood samples were transferred to the lab and analyzed by Biochemistry Analyzer Hitachi 717. The amount of the serum copper concentration was calculated (according to nano gram per micro liter) by using statistical software (SPSS-16) and paired sample T-test method.

3. Results

As you see in table 2 the mean and the standard deviation of 3-stage examinations of blood serum copper in scale of nano gram per micro liter are registered. At the first stage, the mean of subjects' blood serum copper concentration was 0.766 nano grams per micro liter. In the second stage, this concentration increased to 0.808 nano grams per micro liter and in the third one it decreased to its primitive state, which was 0.769 nano gram per micro liter. The research result indicated that serum copper concentration was not significant in the first and the second stages ($p = 0.523$) and also it was not significant between the first and the third stages of the research ($p = 0.93$) and between the second and the third stages of the research ($p = 0.592$) Figure 1.

Table 1. Physical characteristics of the subjects

Variables	Mean	Standard Deviation
Weight (kg)	75.50	8.027
Height (cm)	176.60	7.026
Age (yr)	23.47	1.79
BMI (cm^2)	24.22	2.34
Systolic blood pressure (mm Hg)	117.00	3.00
Diastolic blood pressure (mm Hg)	77.00	4.83
VO_2 max ml^{-1}. min^{-1}	60.44	5.21

Table 2. The Changes of Serum Cooper (Cu) with P and t Values in Three Stages

Variables (n gr/mic L)	Mean	Standard Deviation	T Value	P Value
Cu 1	0.7660	0.12276	0.664	0.523
Cu 2	0.8080	0.20132	0.090	0.930
Cu 3	0.7690	0.07340	0.555	0.592

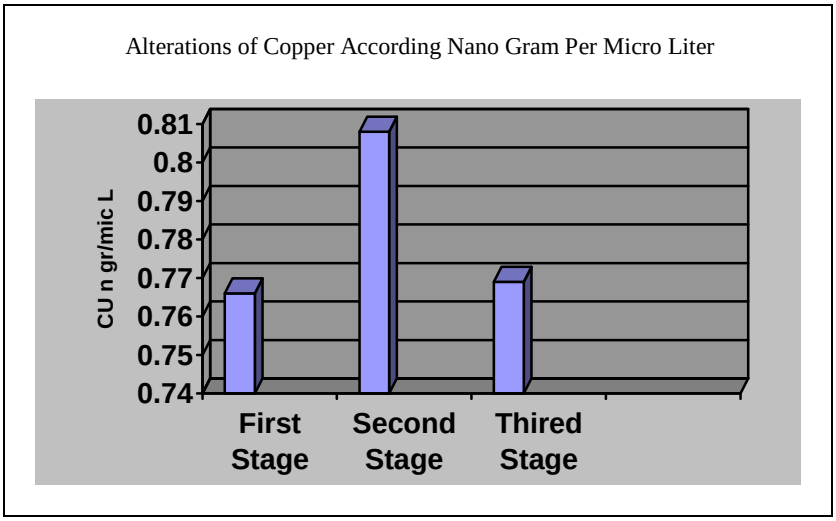

Fig. 1. The Changes of Copper after Three Blood Sampling

4. Discussion and conclusion

The purpose of this research is the study of serum copper (CU) alteration in the scale of nano gram per micro liter by using exhausting and aerobic exercise. A very slight decrease in the scale of nano gram per micro liter can have a negative effect on the athletes' manner and performance. Copper reduction can also affect the enzymes' function. It can prevent anemia in people and athletes and also facilitates iron absorption. In this research fourteen male subjects participated. In three stages blood samples were taken from the elbow vein. Results of the research indicated that there is no significant difference between the rest state and after performing Bruce test and the 24-hour rest. These results indicate that athletes' serum copper does not change immediately after strenuous activity ($p = 0.930$).

Many researchers have reported differently on the effect of strenuous activity on copper status [10, 9]. The present research is similar to Marrela et al., research (1993), since the researcher did not observe any changes in copper serum concentration after the exercise. This research is also similar to Anderson's (1995) research [9]. The researcher also did not observe any alteration in serum copper concentration after strenuous and exhausting activity. On the other hand, the present research bears no similarity to the research by Bordin et al., since the researcher observed a reduction of serum copper concentration after activity on treadmill [11]. In the other research which was performed on the mice by Cordova et al., (1990), they observed a kind of augmentation in serum copper concentration which also does not bear any similarity with the present research. Also in another research by Campbell et al., the results indicated that after exercise, copper could be discharged through urination [15].

Different physical activities can probably result in different responses in the concentration of blood serum mineral. Thus, both the intensity and the train duration can make different alternations and responses even in the scale of nano gram per micro liter on athletes' serum copper concentration.

In the present research, the average time of Bruce test, took 18.3 minutes. This time apparently could not make a significant alteration in copper concentration, since short time exercise (18.3 min) is not sufficient for stimulating and mobilizing the copper from liver.

An increase of 0.042 nano grams per micro liter after Bruce aerobic activity (table 2) means an increase in the scale of 5.48 % nano grams per micro liter. This alteration was not significant ($p = 0.930$). Of course, this increasing returned to its first state (about 0.769 nano grams per micro liter) after 24 hours subjects' resting.

The final result indicated that strenuous and exhaustion exercise session can not have any effect on the concentration of serum copper even in the scale of nano gram per micro liter.

Strenuous exercises which are performed in one session can have more effects on other scarce elements like iron [16], calcium, phosphorus and magnesium [17].

It seams that young athletes do not have to be worried about the lack of some scarce elements like copper in their meals. In this case using nutrient supplementation would not be recommended and their daily food can keep the copper concentration in the blood serum in its natural status.

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References

[1] WW. Campbell, RA. Anderson, Sports Med. **4**,9 (1987).
[2] L. M. Klevay, J. Nutr. **130** (Suppl. 25), 489s (2000).
[3] S. Lekhakul, R. Suphavilai, S. Kritalugsana, et al., J. Med. Assoc. Thailand **70**, 583 (1987).
[4] V. W. Bunker, L. J. Hinks, M. S. Lawson, et al., Am. J. Clin. Nutr. **40**, 1096 (1984).
[5] S. I. Baskin, K. P. Kuhar, F. J. Uricchio, et al., Reprod. Nutr. Dev. **21**, 689 (1981).
[6] H. R. Massie and V. R. Aiello, Mech. Ageing Dev. **11**, 219 (1979).
[7] I. Rodriguez Tuya, E. Pinilla Gil, M. Maynar Marino, et al., Eur. J. Appl. Physiol. **73**, 299 (1996).
[8] A. Singh, P. A. Deuster, and P. B. Moser, J. Sports Med. Phys. Fitness **30**, 29 (1990).
[9] R. A. Anderson, N. A. Bryden, M. M. Polansky, et al., Analyst **120**, 867 (1995).
[10] M. Marrella, F. Guerrini, P. L. Solero, et al., J. Trace Elements Electrolytes Health Dis. **7**, 248 (1993).
[11] D. Bordin, L. Sartorelli, G. Bonanni, et al., Biol. Trace Element Res. **36**, 129 (1993).
[12] P. A. Deuster, S. B. Kyle, A. Singh, et al., J. Sports Med. Phys. Fitness **31**, 552 (1991).
[13] I. Cordova, M. Gimenez, and J. F. Escanero, Physiol. Behav. **48**, 595 (1990).
[14] O. I. Aruoma, T. Reilly, D. MacLaren, et al., Iron, Clin. Chim. Acta **177**, 81 (1988).
[15] W. W. Campbell and R. A. Anderson, Sports Med. **4**, 9 (1987).
[16] M. J. Pourvaghar, A. R. Shahsavar, Dig. J. Nano. Bio. Vol. **4**(3), 501 (2009).
[17] M. J. Pourvaghar, Gaz. Med. Ita. Vol.167, NO. **3,** 105 (2008).