Asian Journal of Chemistry Vol. 20, No. 4 (2008), 3203-3208

Comparison of Urine and Blood Zinc Levels of Futsal Players Before and After The Match

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This study is concerned the determination of the changes in urine and blood zinc levels of the players before and after a futsal match. The mean pre and post match concentrations were found as 1.4370 ± 0.3808 and 3.1230 ± 2.1627 μg/dl which marked a statistically significant increase. The results were in good accordance with literature.

Key Words: Zinc, Urine, Blood, Futsal, Anodic stripping voltammetry.

INTRODUCTION

Zinc is a trace element which takes part in the activity of more than 300 enzymes. The loss of zinc causes anorexia, loss of weight, decreased endurance, exhaustion and osteoporosis[1]. Speich *et al.*[2] in their review of minerals and trace elements state that the related data are often contradictory and incomplete. It is still unclear in many cases how minerals are involved in physiological changes and much work remains. It was also reported that low serum zinc levels increased the viscosity of blood and caused decrease in performance[3]. Haralambie[4] determined serum zinc levels in 160 training athletes (57 females) in the morning at rest. In 23.3 % of the male and 43 % of the female athletes, serum Zn was lower than the limit accepted for the normal range (75 μg/dl or 11.5 μmol/L). Brun *et al.*[5] found that the serum zinc level of female gymnasts were less than those of male gymnasts (0.557 ± 0.023 *vs.* 0.651 ± 0.044 mg/L). They also found that the serum levels of sedentary subjects was significantly higher than those of the gymnasts (0.81 ± 0.014 mg/L *vs.* 0.599 ± 0.026 mg/L), Lukaski *et al.*[6] also verified that the serum zinc levels of female swimmers were lower than those of males (12.7 ± 0.1 to 14.6 ± 0.6 mmol/L). Cordova *et al.*[7] investigated the change in serum Zn levels as a result of acute exercise on 12 volleyballs players and 12 controls and found that there was a significant increase the discharge in volleyball players *via* sweat. Van Loan *et al.*[8] investigated the effects of zinc depletion on peak force and total work of knee and shoulder and found that isokinetic exercise resulted acute depletion serum zinc levels which caused significant total loss work capacity of muscles. Bordin *et al.*[9] investigated high intensity physical exercise induced effects on plasma levels of copper and zinc and found that plasma copper concentration decreased and plasma zinc concentration increases, after exercise, in both males and females. Kilic *et al.*[10] suggest that zinc supplementation has a positive effect on hematological parameters in athletes.

Although there are numerous studies in serum and plasma zinc levels the studies carried out in urine and sweat discharge levels are highly limited. Kikukawa *et al.*[11] studied changes in urinary zinc and copper in 11 people working in Japan aerial rescue team with 11 h strenuous physical exercise. The workers reported control, pre, basic and strenuous exercise zinc levels as 0.99, 1.91, 1.83 and 2.49 mmol/L, respectively. Deruisseau *et al.*[12] showed that the zinc discharged with sweat showed a decrease after prolonged exercise in this study they carried out on 9 women and 9 male cyclists. Saraymen *et al.*[13] on the other hand found that the sweat levels of zinc of amateur boxer showed a significant increase as result of 30 acute training periods. Saraymen *et al.*[14] verified the same phenomenon in another study they carried out on wrestlers. Rodriguez and Diaz[15] found that concentrations and excretions of Zn were significantly ($p < 0.015$) lower when the urinary pH was above 7. They observed a significant depletion of urinary Zn and Cu concentration and Fe excretion was found in the subjects who usually did physical exercise. Anderson *et al.*[16] found that changes in urinary losses of Zn and Cu, associated with the acute strenuous exercise of short duration, were not significantly different. Campbell and Anderson[17] claimed that aerobic exercise resulted increased zinc losses in urine and sweat suggesting an altered metabolism and/or nutritional status of the trace minerals in trained individuals and those who exercise strenuously.

Mundie *et al.*[18] had 12 healthy male volunteers perform two resistance exercise sessions: Moderate resistances (MR) exercise session and heavy resistances (HR) exercise session. They found that increase in plasma Zn and decreases in erythrocyte Zn after strenuous running, treadmill or cycle ergometry exercise which supports the suggestions that increases in plasma Zn levels are the result of leakage from the muscles resulting from muscle damage. Cordova and Alvarez-Mon[19] found that the variations in plasma zinc levels are dependent on the intensity of exercise. It is clear that there are short-term effects of exercise on zinc metabolism. It has also been shown that a high level of constant exercise can have long-term effects on zinc metabolism. It has been reported that runners have lower plasma zinc levels than controls. Long term endurance training has been shown to significantly decrease resting serum zinc levels in both male and female athletes compared to sedentary controls.

Couzy *et al.*[20] observed a significant decrease in serum zinc after five months of intensive training (all values remaining in the normal range) which could not be explained by changes in dietary habits, plasma protein concentrations, hormonal changes nor by the existence of minor infectious or inflammatory pathologies. These results support the hypothesis that zinc status may be slightly altered in the high-level athlete.

Lukaski *et al.*[21] reported that acute, intense activity results in short-term increases in both urine and sweat losses of minerals that apparently diminish during recovery in the days after exercise. Supplemental magnesium and zinc apparently improve strength and muscle metabolism. However, evidence is lacking as to whether these observations relate to impaired nutritional status or a pharmacologic effect. The indiscriminate use of mineral supplements can adversely affect physiologic function and impair health.

EXPERIMENTAL

This study was carried out on 10 professional soccer players with an average age of 20.40 ± 0.84 year, an average height of 175 ± 7.89 cm an average body weight of 69.70 ± 7.82 kg and an average sport age of 6.50 ± 1.84. Two urine samples were taken from the players before and after the semifinal game in the futsal (court soccer) nationwide tournament between the universities in Turkey. The samples were analyzed as regards to zinc content by the use anodic stripping voltammetry.

Voltammetric procedure: The trace elements analyses of the samples were carried out by the use of square wave stripping voltammetry under the conditions given in Table-1. The electrochemical analysis were performed computer controlled CHI660B model potentiostat and BAS CGME hanging mercury drop electrode. The working electrode was 100 mm capillary mercury electrode and the counter and reference electrodes were a Pt wire and Ag/AgCl (3 M NaCl) electrodes. The residual oxygen in the system was removed by purging argon gas with spectrophotometric purity. The peak potential for Zn^{2+} was 1.05 V (Ag/AgCl) under the conditions stated in Table-1 (Fig. 1).

TABLE-1
ELECTROCHEMICAL ANALYSIS CONDITIONS OF SQUARE WAVE STRIPPING VOLTAMMETRY

Deposition potential	-1.250 V	Frequency	30 Hz
Deposition time	150 s	Rest time	15 s
Scan rate	2 mV	Stirring rate	350 rpm
Amplitude	25 mV	–	–

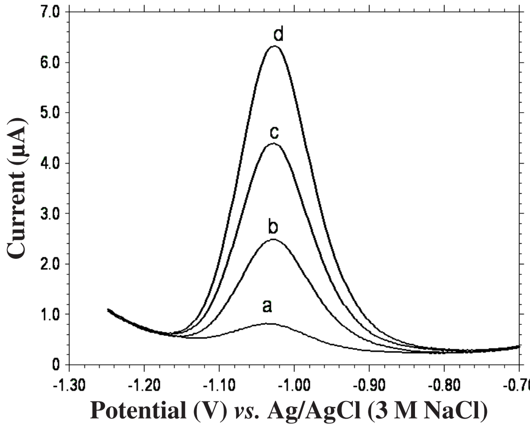

Fig. 1. Square wave anodic square wave voltammograms of Zn^{2+} peak located at -1.05 a) 0.5 mL sample + 2 mL acetic acid-acetate buffer b) addition of 20 mL 10^{-4} M Zn^{2+} c) addition of 40 mL 10^{-4} M Pb^{2+} d) addition of 60 mL 10^{-4} M Zn^{2+}

Statistical analysis: The data obtained were evaluated by SPSS 10.0 statistics software and t-test at 0.05 significance level.

RESULTS AND DISCUSSION

The raw and statistical values were tabulated in Table-2. The post match values are higher than those pre match values. This is in good compliance with the Kikukawa *et al.*[11] and Campbell and Anderson[17] who reported the increased loss of zinc after strenuous exercise. Marrella *et al.*[22] found that pre and post competition plasma and total zinc level of 16 marathon runners showed a decrease of 30 %. Lukaski *et al.*[23] in their study carried out on 16 female and 13 male swimmers investigated the effect of physical training on zinc levels found no change of statistical importance between the pre and post season levels. The Zn levels ranged between 12.7 ± 0.5 and 14.3 ± 0.5 mmol/L. Ohno *et al.*[24] investigated the effect of exercise on plasma Zn levels of seven sedentary students at the age of 17-18 years and found that the level showed a slight decrease from 79.7 ± 2.7 to 78.0 ± 3.1 μg 100 mL^1. Savas[25] on the other hand showed that six week maximal loading showed a significant decrease in blood zinc level which effected other performance parameters. However, these results contradicted the findings of Anderson *et al.*[16] who claimed that the urine zinc levels did not show a significant change after an exhaustive physical activity. This shows the need of the studies with larger sample groups in order to verify this effect.

Table-3 reveals that there was a statistically significant difference between the pre and post match urine Zn levels of the participants ($p < 0.05$), while Table-4 reveals that there was a statistically non-significant difference between the pre and post match blood Zn levels of the participants ($p < 0.05$).

TABLE-2
RAW VALUES OF THE PLAYERS PARTICIPATED IN THE STUDY

Players	Ave (years)	Height (cm)	Weight (Kg)	Active sports life (years)	Pre match urine Zn value (µg Zn/dl urine)	Post match urine Zn value (µg Zn/dl urine)	Pre match blood Zn value (µg Zn/dl blood)	Post match blood Zn value (µg Zn/dl blood)
1	20	172	66	8	1.03	4.76	9.85	18.60
2	19	180	71	6	1.45	1.57	12.0	14.40
3	20	165	61	5	1.05	1.68	2.27	5.23
4	20	170	65	8	1.81	2.96	16.9	29.40
5	22	182	83	9	1.88	1.99	13.2	19.60
6	20	177	70	8	1.19	1.21	6.09	7.21
7	21	166	63	6	1.48	3.61	14.7	35.90
8	20	187	81	7	2.05	8.3	20.5	9.74
9	21	185	75	5	1.01	3.65	3.65	10.10
10	21	170	62	3	1.46	1.50	32.5	38.60
Mean	20.40	1.75	69.70	6.50	1.84	3.123	3.2884	3.8911
SD	0.84	7.89	7.82	1.84	0.376	2.052	2.7430	2.7910
Min.	19	1.65	61	3	1.01	1.21	1.20	1.01
Max.	22	1.87	83	9	2.05	8.30	9.85	9.74

TABLE-3
t-TEST RESULTS OF THE PRE AND POST MATCH URINE Zn CONCENTRATIONS OF THE PLAYERS PARTICIPATED INTO THE STUDY

Variables	N	Mean	Difference between mean values	Standard deviation	Standard error mean	t.	p
Pre match	10	1.441	-1.6820	2.0531	0.6492	2.591	0.029*
Post match	10	3.123					

*p < 0.05.

TABLE-4
t-TEST RESULTS OF THE PRE AND POST MATCH BLOOD Zn CONCENTRATIONS OF THE PLAYERS PARTICIPATED INTO THE STUDY

Variables	N	Mean	Difference between mean values	Standard deviation	Standard error mean	t.	p
Pre match	10	3.2884	-0.6027	3.98818	1.26117	0.478	0.644*
Post match	10	3.8911					

*p < 0.05.

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(*Received*: 3 October 2007; *Accepted*: 19 January 2008) AJC-6234