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Examination on the Effect of Swimming Exercises Applied with Co Enzyme Q10 and Zinc Supplementation on the Ast-Alt Metabolism in Young Athletes

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Abstract: In that study, it has been aimed to determine the effect of zinc and CoQ10 supplementation applied with 8-week swimming exercises on AST-ALT metabolism.
Our study was conducted on 36 voluntary male athletes aged 18-22 who do physical exercises actively. The participants were divided equally into 4 groups. The groups were constituted in that way: 1st Group: Group which is supplied with zinc (Z), 2nd Group: Group which is supplied with Coenzyme Q10 (Q), 3rd Group: Control Group who does physical exercises (C) and 4th Group: Group which is supplied with Zinc and Coenzyme Q10 (ZQ). At the first week of the study, AST and ALT levels of the participants were measured from the samples which were drawn from the participants at pre-exercise resting period (PRP), post-exercise pre-test fatigue (PTF) and pre-exercise post-test rested (PTR) and post-exercise post-test fatigue (PTF) after 8-week supplementation period. In consequence of the conducted analysis, it was identified that rested AST levels of the group supplied with zinc were higher than their fatigue levels after 8-week supplementation period ($p<0.05$). As for ALT values of the group supplied with zinc, the post-test fatigue values were found lower than the pre-exercise rested and after 8-week exercise rested values ($p<0.05$). The post-test fatigue (PTF) values of the control group were determined lower than their post-test rested (PTR) values ($p<0.05$). It was identified statistically significant differences between not only PostTF and PostTR values but also PostTR and PreTR values of the group supplied with Zinc and Coenzyme Q10 ($p<0.05$). Consequently, it was confirmed that zinc and CoQ10 supplementation applied with 8-week swimming exercises had influence over the AST and ALT metabolism. It can be said that the antioxidant supplementation makes significant contributions as the AST and ALT metabolism are active.

Keywords: *Zinc; CoQ10; AST and ALT; swimming.*

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1. Introduction

Alanine aminotransferase (ALT) which is also called glutamate-pyruvate transaminase (GPT) can be found in many tissues. That enzyme transfer's ∞ ketoglutareta to alanine amino groups and in conclusion pyruvate and glutamate develop. The reaction is reversible; nevertheless, that enzyme works toward glutamate synthesis as all aminotranferases during amino acid catabolism. Thus, glutamate works like a nitrogen collector. Aspartate aminotransferase (AST) is also called glutamate-oxaloacetate transaminase (GOT). The reaction catalyzed by that enzyme operates in order to form aspartate instead of glutamate differently from the other aminotransferases. Aspartate aminotransferase transfers the amino groups from glutamate to oxaloacetate during the amino acid catabolism and the generated aspartate gets into urea cycle as a nitrogen source (Murray, Granner, Mayes, & Rodwell, 1996; Champe & Harvey, 1997). Aminotransferases (ALT, AST) are not specific to liver although they are one of the liver function tests. Though AST is primarily found in liver and heart, it is also found in muscular tissue, red blood cells, pancreas, kidney and brain. Accordingly, it is expected serum AST levels to increase in the case of organ damages or haemolysis. That increase generally shows parallelism with the prevalence of the damage (Burris, Ashwood, & Burns, 2006). ALT is primarily found in liver and kidney. ALT is more specific in demonstrating and monitoring the liver functions than AST (Giboney, 2005).

CoQ10 is a lipophilic, endogenic antioxidant which is a fundamental component of quinol and mitochondrial electron transport chain similar to an oil-soluble vitamin (Torlak, Okudan, Gökbel, Belviranli, & Kıyıcı, 2000). Although antioxidants are produced by the body, their level decreases owing to aging, life style and environmental factors. CoQ10, as a good antioxidant, participates in respiratory chain electron and proton transport at mitochondrial inner membrane, and prevents free radical oxidation in cells and tissues by decreasing oxidative stress. In several studies, it has been demonstrated the potential efficacy of CoQ10 in various diseases arising out of oxidative stress and decreased antioxidant capacity and mitochondrial disorders (Gurkan & Bozdağ-Dündar, 2005). Any case that causes oxidative stress increase reduces the role of CoQ10 in oxidative phosphoylation by increasing its usage as an antioxidant (Mancini, Festa, Raimondo, Pontecorvi, & Littarru, 2011). CoQ10 is found in mitochondria and main mitochondria membrane and plays key role in energy production. CoQ10 is used in treatments of disorders that result from oxidative damage and cellular energy metabolism deficiency. Even though exercise-induced muscle injury is not medically a sports injury, it affects significantly the performance of the athletes. Different types of exercises cause muscle injury depending on different contraction types. Furthermore, eccentric contraction creates more muscle injuries than the other contraction types. CoQ10 increases the sportive performance by decreasing oxidative injury and contributing to cellular energy metabolism (Torlak et al., 2000).

Zinc is one of the significant trace elements (Prasad, 1982). Zinc is a bivalent cation and does not have a monovalent or trivalent version in physical conditions. Insufficient zinc intake, particularly inadequate protein intake, abnormal losses from bowel such as steatorrhoea and enteritis, micturition forced by diuretics and zinc losses resulting from extreme perspiration in hot weather are some reasons of zinc insufficiency (Taneli, 2005). Zinc has several biological functions (Pathak, Dhawan, & Pathak, 2011). It has a significant role on the immune system, energy generation, growth and healing and reconstruction in the muscular tissue (American Dietetic Association, 2003). It has not been proven that zinc intake benefits the physical performance (American Dietetic Association, 2009).

In the light of information, the aim of this study is to examine the effect that zinc and CoQ10 supplementation applied with 8-week swimming exercises may create on the AST-ALT metabolism. The paper is equal contribution of all authors.

2. Material and Methods

2.1. Subjects

36 voluntary male athletes whose average of age is 19.40±1.46 years and average of weight is 62.05±7.19 studying at Erciyes University School of Physical Education and Sports and doing actively physical exercises in different branches participated in our study.

2.2. Procedure

The athletes were equally and randomly divided into 4 groups regarding their age and weight, which is shown below. For 8 weeks, all groups conducted daily 60 minutes swimming exercises 5 days a week. Along with the exercises; 1st Group was supplied with 22 mg zinc 20-30 minutes later than dinner once a day, similarly 2nd Group was supplied with 100 mg coenzyme Q10, 4th Group was supplied with both 22 mg zinc and 100 mg tablet coenzyme Q10 in addition to the normal diet for 8 weeks, and

3rd Group was not given any supplementation (Table 1). The pretest-posttest design was used in that study.

Table 1. Research Groups

1st Group:	n:9	Exercise Supplied with Zinc
2ndGroup:	n:9	Exercise Supplied with Q 10
3rd Group:	n:9	Only Exercise
4th Group:	n:9	Exercise Supplied with Zinc and Q 10

2.3. Identification of the Participants' Biochemical Parameters

At the beginning and at the end of 8-week program, blood samples were drawn from the athletes both rested and fatigue cases in total 4 times. After the samples were centrifuged at 4000 rpm^3 for 10 minutes, AST and ALT levels were determined. The participants did freestyle swimming exercises until they feel tired; thus, fatigue was ensured.

2.4. Examination of the Blood Samples

The blood samples were centrifuged at 4000 rpm^3 for 10 minutes and the blood plasma fractionation was done. The measurement of the required parameters was carried out at the central laboratory of Erciyes University Faculty of Medicine. The determination of AST and ALT levels were done in a controlled way through Siemens ADVIA 1800 chemistry system device and the findings were calibrated.

2.5. The Statistical Analyses

The statistical analyses were conducted via SPSS 22 (SPSS Inc., Chicago, IL, USA). All measured parameters, mean values and standard errors of all subjects were calculated. The Related-Samples Friedman's Two-Way Analysis of Variance by Ranks test was used to identify the differences between the values of the groups obtained through measurements; the significance level was determined as $p<0.05$.

3. Results

Table 2 AST Values of the Research Groups

AST (U/L)				
Groups	**Pretest Rested (PreTR)**	**Pretest Fatigue (PreTF)**	**Posttest Rested (PostTR)**	**Posttest Fatigue (PostTF)**
Exercise Supplied with Zinc	22.00(21.00-24.50) abc	22.00(18.00-25.50) bc A	25.50(23.00-30.00)c AB	21.00(17.75-25.25)dab
Exercise Supplied with Q 10	26.50(21.75-27.75)	24.50(22.75-31.25) B	29.00(28.75-29.25) B	25.00(19.00-28.75)
Only Exercise	24.00(21.75-28.00)	26.00(22.50-26.50) AB	31.00(25.00-34.25) B	26.00(25.00-28.25)
Exercise Supplied with Zinc and Q 10	24.50(20.00-28.00)	25.00(20.00-30.00) AB	22.50(19.00-29.25) A	22.50(21.00-29.00)

* The differences between the average values at the same column are important (P<0.05).
The differences in average values that carry different letters at the same line are important (abcd)
The differences in average values that carry different letters at the same column are important (ABCD)

It was identified statistically significant differences between the PostTR (Posttest rested) and PostTF (posttest fatigue) values of the 1st group supplied with zinc (p<0.01). However, any significant difference was not determined between the pretest rested, pretest fatigue, posttest rested and posttest fatigue values of the 2nd group supplied with Q 10 (p>0.05). Similarly, it was not observed any significant differences between the pretest rested, pretest fatigue, posttest rested and posttest fatigue values of the 3rd group who does only physical exercises (p>0.05). Any significant difference was not identified between the pretest rested, pretest fatigue, posttest rested and posttest fatigue values of the 4th group supplied with zinc and Q 10 (p>0.05).

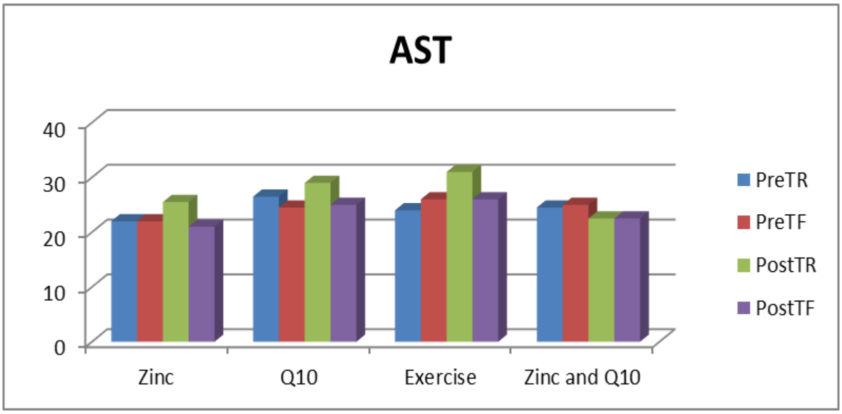

Figure 1. Within Group and Between Group Distribution of AST Level by Different Schedules

Table 3. ALT Values of the Research Groups

	ALT (U/L)			
Groups	**Pretest Rested (PreTR)**	**Pretest Fatigue (PreTF)**	**Posttest Rested (PostTR)**	**Posttest Fatigue (PostTF)**
Exercise Supplied with Zinc	16.00(11.00-20.25) ac	16.00(09.00-20.75) abc	16.00(12.00-22.50) c B	13.50(10.00-16.00) db A
Exercise Supplied with Q 10	18.00(16.75-22.50)	17.00(13.75-27.25)	20.50(17.50-23.25) B	16.50(14.75-21.00) B
Only Exercise	18.00(14.75-19.00) ac	15.00(13.75-16.50) abc	18.50(15.75-20.00) c B	14.00(13.50-14.00) db AB
Exercise Supplied with Zinc and Q 10	14.50(13.75-16.25) ab	12.00(10.00-16.75) bc	11.00(10.00-13.75) c A	13.50(12.00-17.00) dab AB

* The differences between the average values at the same column are important (P<0.05).
The differences in average values that carry different letters at the same line are important (abcd)
The differences in average values that carry different letters at the same column are important (ABCD)

It was identified a significant decrease in the PostTF (Posttest fatigue) levels of the 1st group supplied with zinc in comparison with its PreTR (pretest rested) values (p<0,05). The group's PostTF (posttest fatigue) values were significantly lower than the PostTR (posttest rested) values (p<0,001). However, any significant difference was not determined between the PreTR (pretest rested) and PreTF (pretest fatigue) values and also PostTR (posttest rested) and PostTF (posttest fatigue) values of the 2nd group supplied with Q10 (p>0,05). It was observed statistically significant differences between the PostTF (posttest fatigue) and PostTR (posttest rested) values of the 3rd group who does only physical exercises (p>0,05). Nevertheless, it was identified a significant decrease in the group's PostTF (posttest fatigue) values in comparison with the PreTR (pretest rested) values (p<0,01). It was observed a statistically significant increase in the PostTF (posttest fatigue) values of the 4th group supplied with zinc and Q 10 in comparison with the PostTR (posttest rested) values (p>0,05). Furthermore, a significant difference was determined between the PostTR (posttest rested) values of the same group and the PreTR (pretest rested) values (p<0,01).

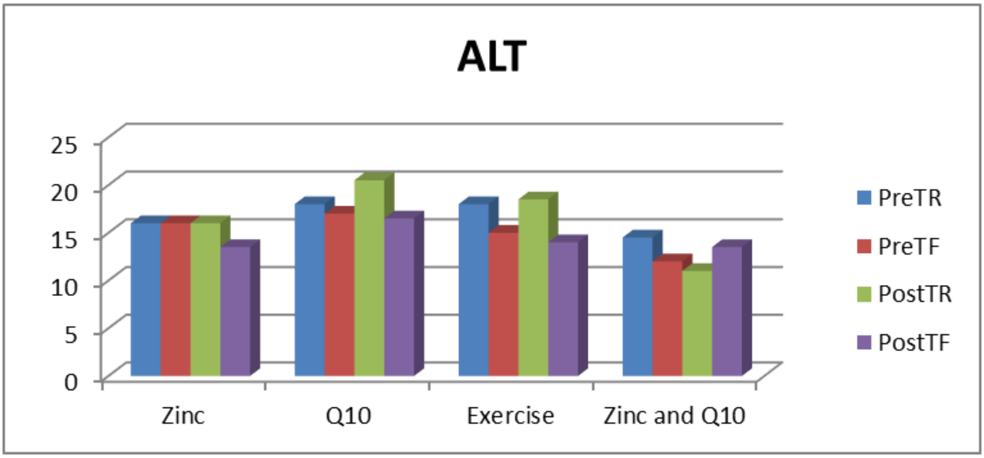

Figure 2. Within Group and Between Group Distribution of ALT Level by Different Schedules

4. Discussion

In that study which aimed to examine the effect of the zinc, Q10 and zinc+Q10 supplementation applied five times a week during 8 weeks along with daily 60-minute swimming exercises on the AST and ALT metabolism, the participants' AST and ALT levels were examined through the blood samples drawn 4 times from them to analyze their pretest rested and fatigue and posttest rested and fatigue levels. Considering the differences observed in consequence of analyzing the blood samples, 8-week zinc and Q10 supplementation constituted significant influences on the AST and ALT metabolism.

When the effect of doing exercises on AST and ALT are examined in literature, different results are obtained. In several studies conducted on the long-distance runners, it was determined that AST and ALT values increased. In the studies carried out on the ultra-marathoners (200 km) (Hyo, Zoon, & Chang, 2007), non-stop runners (246 km) (Skenderi, Kavouras, Anastasiou, Yiannakouris, & Matalas, 2006), professional bike racers (800km-2700km) (Mena, Maynar, & Campillo, 1996), ultra-marathoners (1600 km) (Fallon, Sivyer, Sivyer, & Dare, 1999), ultra-marathoners (100km), it was reported that AST and ALT values increased (Wu, Chen, Shee, Huang, & Yang, 2004). In a study conducted on young long-distance runners (21 km), it was found out AST values increased; however, any change was not observed in the ALT values (Nie et al., 2011). In another study done on 19-year old 100 young athletes from different branches, it was reported that AST values increased but ALT values did not show any change (Fallon, 2008). The increase in the intensity and term of the exercise generally increases the AST and ALT values (Rosmarin, Beard, & Robbins, 1993).

It was confirmed statistically significant increases in ALT and AST levels of the athletes after the training program applied to them within the 20-day camp period (Mashiko, Umeda, Nakaji, & Sugawara, 2004). At the end of the 5-week training program conducted with 16 male and 8 female judo its, increase in the AST and ALT levels of the participants was reported (Su et al., 2001). In another study carried out on 203 volunteer, it was identified significant increases in the AST and ALT levels of the participants (Clarkson, Kearns, Rouzier, Rubin, & Thompson, 2006). In another study which examined certain hematologic and biochemical parameters of young male athletes joining the World Taekwondo Championships during their acute training period, it was reported that the AST and ALT levels of the participants were within the indicated normal human alteration boundaries (Bezci, 2007). Studies in recent years have showed that heavy physical activities like lifting weights is one of the reasons of AST height (Uygun and Polat, 2009). In our study, it was observed that fatigue values of the control group which were not given any supplementation were lower than their posttest rested values at the end of the 8-week training. Rested values of the same group after 8-week exercise were found lower than the post training levels at the end of the first week. It is known that changes are observed in blood parameters and biochemical levels depending on the type, intensity and term of the exercise. The differences seen in the findings of the studies may result from the intensity, term and type of the exercises and the age, gender, body fat percentage, performance levels and nutrition levels of the participants.

There is not adequate studies in literature that show how zinc affect the hematologic parameters during exercises. It is seen that the studies have been mainly focused on how doing exercises affect the hematologic parameters. As the blood parameters influence the type and intensity of the exercises, exercises have influence over the blood parameters and are essential to various blood pathologies. It is thought that zinc insufficiency affects the mentioned parameters negatively while zinc application affects them positively. Zinc application may increase the physical performance (Baltaci et al., 2003). In a study which examines the effect of the zinc supplementation on free radical formation and antioxidant system of wrestlers, it is stated that the physiologic doses of the zinc reinforcement may contribute to the athletes' favored health and performances (Kara et al., 2010). In our study, it has been determined that the rested AST values of only the group supplied with zinc after 8-week were higher than the fatigue AST values after 8-week. At the end of the 8-week swimming exercises, the fatigue ALT values of the same group (the one supplied with only zinc) were found lower than both the pre-training rested values and post 8-week training rested values. However, at the group supplied with zinc and Q10, after 8-week swimming trainings fatigue values were found higher than post 8-week training rested values. It was confirmed that post 8-week training rested values were lower than the pre 8-week training rested values.

In a study which was conducted on young sedentary males to examine the effect of CoQ10 supplementation on the eccentric exercise induced muscle injury, it was found out 4-week CoQ10 supplementation increased the CoQ10 level in blood but it did not affect the exercise induced muscle injury (Torlak et al., 2000). In another study examining the effect of CoQ10 supplementation given to the lipid peroxydation on the exercise performance of the trained cyclists, any statistically significant difference was not found between two groups although both groups made progresses in all physiologic parameters regarding the training during the study (Braun, Clarkson, Freedson, & Kohl, 1991). The serum zinc levels decrease with the 8-week kick box exercise and numerous findings regarding that matter can be found in literature. It was confirmed that zinc levels of the child athletes did not affect by doing exercises. Nevertheless, it was stated that rested zinc levels of male athletes significantly decreased with long-term endurance training. In conclusion, it may be said that the differences vary depending on age and the sports done. In another study, it was found out the zinc supplementation given to kick box athletes might be affect the blood parameters and performances in positive way (Polat, 2011). It was determined that plasma CoQ10 levels increased following 2-week CoQ10 usage (Cooke et al., 2008). The aerobic strength and exercise economy and muscle and plasma CoQ10 concentration evaluation was done on the healthy males who supplied with CoQ10 for 4 weeks. It was found out the plasma CoQ10 concentration was significantly high in the participants who were given enzyme supplementation. However, any statistically significant difference was not identified in pre and post exercise values of the participants. Similarly, it was not observed any significant alteration in the muscle CoQ10 concentration, VO2max ventilation threshold, exercise economy and anoxia of the participants given coenzyme supplementation (Zhou et al., 2005).

5. Conclusion

According to our study, it was determined the acute training program caused changes in certain hematologic and biochemical parameters in athletes but these changes were within the reference intervals provided by the Central Laboratory of Erciyes University Faculty of Medicine. Furthermore, they are within the normal alteration boundaries given in the literature; therefore, it can be said the changes at least are not risky with regard to the measured parameters.

Consequently, it can be said the zinc and CoQ10 supplementation which were given individually or together and applied with swimming exercises 5 days a week for 8 weeks made positive contributions to the health and sportive performance of the athletes by creating significant changes on their AST and ALT metabolism.

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