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Effects of CoQ10 and zinc supplemented trainings upon some blood parameters.

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Abstract

In this study, it was aimed to investigate the effects of zinc and CoQ10 supplements upon 8-week training programs. Totally 32 male players were included into the study. The players were categorized into 4 groups as only zinc supplement, only CoQ10 supplement, both zinc and CoQ10 supplement, and non-supplemented control including 8 each. Hemoglobin, hematocrit, erythrocyte, leucocyte and thrombocyte values of the experiments in both in rested and fatigue situations were determined. Obtained data were entered into SPSS 22.0 statistical software program, and subsequently, Friedman's relational sample two-way variance analysis was used for determining the difference in groups.

At the end of the statistical analysis, some increase in total WBC values was noticed between pre-test and post-test (p<0.01). No significant difference was observed in MCV, MCH, MCHC and Hb values. In terms of Htc value, more increase in post-tests was determined rather than the pre-tests (p<0.01).

Consequently, it was concluded that Zinc and CoQ10 supplement did not create a significant difference upon the physiologic values in participants who were administered with short-medium term and medium-intensity exercise programs. It was possible to consider that higher performances of players could be obtained through long-term training programs administered with zinc and CoQ10.

Keywords: Zinc, CoQ10, Hemoglobin, Hematocrit, Erythrocyte, Leucocyte, Thrombocyte.

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Introduction

The effects of exercise upon biochemical parameters can vary according to the properties of individuals, period of exercise, physical conditions, period and heaviness of exercise and different lipid values [1]. Blood parameters affect type and heaviness of the exercise as well as exercise's affecting blood parameters [2]. Physical activity is an important function of living being systems. Like affecting several systems, it is possible to affect haematological and biochemical parameters. There are different various factors in individuals' adaptation to exercise, adaptation of cardiovascular activity, and in providing physical and physiological balance. Hematologic and biochemical levels are possible to play important role in these factors [3]. Reactive oxygen types appear in muscles due to the high rate of aerobic metabolism. Muscular tissue, especially skeleton and cardiac muscles need high energy. Coenzyme Q10 is closely related with energy consumption [4]. CoQ10, having a role in bioenergy [5], is a key element of ATP production in oxidative phosphorylation chain, and has a strong lipophilic antioxidant property [6]. Furthermore, CoQ10 also plays a role in oxidation-reduction control of cellular signal pathways [7]. Bio-energetic role and antioxidant role of CoQ10 are related with each other. Any case that causes oxidative stress to increase decreases the role CoQ10 in oxidative phosphorylation increasing its use as an antioxidant [8]. Zinc (Zn) is one of the important trace elements [9], and plays an important role in human metabolism [10]. Zinc has several biological functions [11] Zinc is a component of enzymes more than 100, and has various physiological functions in body including normal carbohydrate, lipid and protein metabolism care [12].

Material and Method

Into this study, 32 male players with similar age and body weight were included. The players were categorized into 4 groups including 8 each using random selection method. Group 1 was administered with zinc supplement, Group 2 was administered with CoQ10 supplement, Group 4 was administered with both zinc and CoQ10 supplement, and Group 3 only exercised without any supplements. All groups performed the same exercise protocol for 5 days during the 8-week period. Study groups, measurement times and their abbreviations were presented below.

Groups	n	Group Properties
1st Group	8	Zinc Supplemented Exercise
2nd Group	8	CoQ10 Supplemented Exercise
3rd Group	8	Only Exercise (Control)

4th Group	8	Zinc and CoQ10 Supplemented Exercise

1st Measurement Time	1st week-Rested pre-test before starting to trainings	PTR
2nd Measurement Time	At the end of 1st week- fatigue pre-test	PTF
3rd Measurement Time	At the beginning of 8th week-rested pre-test	PoTR
4th Measurement Time	At the end of 8th week-fatigue post-test	PoTF

Collection of samples and biochemical analyses

To the players in the 1st group, 220 mg zinc tablets were given 20-30 minutes after dinner for once a day during the 8-week period. To the players in the 2nd group, 100 mg CoQ10 tablets were given 20-30 minutes after dinner for once a day during the 8-week period. No supplement was given to the players in the 3rd group. To the players in the 4th group, 220 mg zinc and 100 mg CoQ10 tablets were given 20-30 minutes after dinner for once a day during the 8-week period. Blood samples were taken from each player for four times including as pre-test rested before starting to the 1st week trainings (PTR), pre-test fatigue at the end of 1st week (PTF), post-test rested at the beginning of 8th week (PoTR) and post-test fatigue at the end of 8th week (PoTF). Hemoglobin, hematocrit, erythrocyte, leucocyte and thrombocyte serum samples taken from the experiments were centrifuged (Siemens, ADVIA 1800 chemistry system branded device) for 10 minutes at 1000 turnover in Erciyes University Faculty of Medicine central laboratory.

Exercise protocol

The purpose of this test performed to all groups was to create fatigue in players. Twenty-minute shuttle run test performed with that purpose was a multi-stage test, and its first stage was on a warm-up tempo. The experiments ran 20-minute distance as round-trip. The running speed was controlled with a tape recorder signalling at specific intervals. The players were asked to start running as hearing the first signal sound, and reach to other line until the second. The players adjusted their own tempos in a way they could reach to the other edge of the running track on the second signal sound. The speed that was slow at the beginning increased gradually as once in 10 seconds. The test was ended when players missed two signals successively. By this way, fatigue was created in experiments at the end of the test.

Statistical analyses

The statistical analyses of the data were carried out using SPSS ver. 22 (SPSS Inc., Chicago, IL, USA) statistical software program. Measured parameters, average values and standard errors of all experiments were calculated. Friedman's related samples two-way variance analysis was performed for determining the differences in groups.

Findings

Table 1. *Leucocyte value averages in players who participated into the research according to the groups and intergroup comparisons.*

Group	Pre-Test Rested	Pre-Test Fatigue	Post-Test Rested	Post-Test Fatigue
Zinc Supplemented Exercise	6.55 (5.55-9.02)^{acA}	6.10 (5.25-8.40)^{baA}	9.42 (8.60-12.40)^{cdA}	10.85 (9.47-15.30)^{dA}
Q 10 Supplemented Exercise	6.30 (5.45-7.65)^{abA}	6.75 (5.10-8.85)^{bcA}	10.55 (9.45-11.10)^{adcA}	11.85 (10.37-13.52)^{dA}
Only Exercise	6.70 (522-7.95)^{abA}	6.85 (6.15-8.10)^{bcA}	8.05 (7.07-9.90)^{adcA}	10.15 (9.47-11.32)^{dA}
Zinc and Q10 Supplemented Exercise	6.80 (5.47-7.55)^{abA}	6.70 (5.90-7.30)^{bcA}	9.85 (8.27-10.32)^{cdA}	10.55 (9.90-14.00)^{dA}

*p<0.05; **p<0.01

The difference between the averages with a different letter on the same line was significant.

In zinc-supplemented exercises: significance at the level of $p<0.05$ between pre-test fatigue and post-test rested was determined,

In zinc-supplemented exercises: significance at the level of $p<0.01$ between pre-test fatigue and post-test fatigue was determined,

In zinc-supplemented exercises: significance at the level of $p<0.05$ between pre-test rested and post-test fatigue was determined,

In Q10-supplemented exercises: significance at the level of $p<0.01$ between pre-test rested and post-test fatigue was determined,

In Q10-supplemented exercises: significance at the level of $p<0.05$ between pre-test fatigue and post-test fatigue was determined,

In only exercise: significance at the level of $p<0.01$ between pre-test rested and post-test fatigue was determined,

In only exercise: significance at the level of $p<0.01$ between pre-test fatigue and post-test fatigue was determined (Table 1),

In zinc- and Q10-supplemented exercises: significance at the level of $p<0.05$ between pre-test rested and post-test rested was determined,

In zinc- and Q10-supplemented exercises: significance at the level of $p<0.01$ between pre-test rested and post-test fatigue was determined,

In zinc- and Q10-supplemented exercises: significance at the level of $p<0.01$ between pre-test fatigue and post-test fatigue was determined (Table 2).

Table 2. *Erythrocyte number averages in players who participated into the research according to the groups and intergroup comparisons.*

Group	Pre-test rested	Pre-test fatigue	Post-test rested	Post-test fatigue
Zinc Supplemented Exercise	5.45 (5.22-5.75)^{A}	5.35 (5.20-5.57)^{C}	5.65 (5.52-5.95)^{C}	5.50 (5.25-5.80)^{A}
Q 10 Supplemented Exercise	5.05 (4.90-5.20)^{B}	5.05 (4.92-5.27)^{AB}	5.20 (5.02-5.30)^{AB}	5.15 (4.92-5.27)^{A}
Only Exercise	5.20 (5.02-5.30)^{aB}	5.35 (5.20-5.50)^{abBC}	5.20 (5.20-5.37)^{acB}	5.45 (5.32-5.75)^{dbcA}
Zinc and Q10 Supplemented Exercise	4.95 (4.72-5.25)^{B}	5.00 (4.70-5.10)^{A}	4.80 (4.60-5.32)^{A}	5.15 (4.92-5.35)^{A}

**p<0,01

The difference between the averages with a different letter on the same line was significant (abcd)

The difference between the averages with a different letter on the same column was significant (ABCD)

In pre-test rested; significance at the level of $p<0.05$ between zinc-supplemented exercise and Q10-supplemented exercise, only exercise and Q10-supplemented exercise was determined,

In pre-test fatigue, significance at the level of $p<0.05$ between zinc-supplemented exercise sensitivity and Q10-supplemented exercise was determined,

In pre-test fatigue, significance at the level of $p<0.05$ between zinc-supplemented exercise and zinc- and Q10-suppelmented exercise was determined,

In post-test rested, significance at the level of $p<0.05$ between zinc-supplemented exercise and Q10-supplemented exercise and Q10-supplemented exercise, only exercise and zinc- and Q10-supplemented exercise,

In post-test rested, significance at the level of $p<0.05$ between zinc- and Q10-supplemented exercise and zinc-supplemented exercise, Q10-supplemented exercise and only exercise was determined (Table 3).

Table 3. *Haematocrit value averages in players who participated into the research according to the groups and intergroup comparisons.*

Group	**Pre-Test Rested**	**Pre-Test Fatigue**	**Post-Test Rested**	**Post-Test Fatigue**
Zinc Supplemented Exercise	42.60 (40.57-45.30)^{A}	42.40 (39.72-44.27)^{A}	44.15 (42.00-45.37)^{A}	43.70 (42.95-45.90)^{A}
Q 10 Supplemented Exercise	40.70 (39.62-41.50)^{abAB}	40.20 (39.75-42.85)^{bcA}	42.10 (41.15-42.75)^{adcA}	42.80 (42.02-43.97)^{dB}
Only Exercise	42.65 (41.92-43.17)^{B}	43.40 (42.37-44.57)^{A}	42.55 (42.02-43.77)^{A}	44.05 (42.70-44.92)^{AB}
Zinc and Q10 Supplemented Exercise	39.05 (38.25-41.45)^{acAB}	40.20 (37.80-40.67)^{abA}	39.40 (37.30-41.12)^{bcA}	42.10 (40.75-43.22)^{dAB}

*p<0.05, **p<0.01

The difference between the averages with a different letter on the same line was significant (abcd)

The difference between the averages with a different letter on the same column was significant (ABCD)

In Q10-supplemented exercises: significance at the level of $p<0.01$ between pre-test rested and post-test fatigue was determined,

In Q10-supplemented exercises: significance at the level of $p<0.05$ between pre-test fatigue and post-test fatigue was determined, In zinc- and Q10-supplemented exercises: significance at the level of $p<0.05$ between pre-test fatigue and post-test fatigue was determined,

In zinc- and Q10-supplemented exercises: significance at the level of $p<0.05$ between pre-test rested and post-test fatigue was determined,

In zinc- and Q10-supplemented exercises: significance at the level of $p<0.05$ between post-test rested and post-test fatigue was determined.

Table 4. Thrombocyte number averages in players who participated into the research according to the groups and intergroup comparisons.

Group	Pre-test rested	Pre-test fatigue	Post-test rested	Post-test fatigue
Zinc Supplemented Exercise	270.00 (209.25-304.50)^{abA}	257.00 (223.25-298.75)^{bcA}	327.00 (291.00-432.25)^{cdA}	379.50 (316.00-489.00)^{dA}
Q 10 Supplemented Exercise	302.50 (230.75-394.50)^{aA}	266.50 (239.25-329.50)^{abA}	401.50 (300.00-445.50)^{acA}	368.50 (341.50-411.75)^{dbcA}
Only Exercise	276.50 (245.75-289.50)^{abA}	311.00 (270.25-333.75)^{bcA}	346.00 (327.00-389.25)^{cdA}	411.50 (379.25-446.00)^{dA}
Zinc and Q10 Supplemented Exercise	281.50 (237.50-345.00)^{abA}	262.50 (213.00-313.50)^{bA}	369.50 (260.50-446.25)^{acA}	413.50 (361.00-425.75)^{daA}

In zinc-supplemented exercises: significance at the level of $p<0.05$ between pre-test rested and post-test rested was determined (Table 4),

In zinc-supplemented exercises: significance at the level of $p<0.01$ between pre-test rested and post-test fatigue was determined,

In zinc-supplemented exercises: significance at the level of $p<0.01$ between pre-test rested and post-test fatigue was determined,

In Q10-supplemented exercises: significance at the level of $p<0.05$ between pre-test rested and post-test fatigue was determined,

In only exercise: significance at the level of $p<0.05$ between pre-test rested and post-test rested was determined,

In only exercise: significance at the level of $p<0.01$ between pre-test rested and post-test fatigue was determined,

In only exercise: significance at the level of $p<0.05$ between pre-test fatigue and post-test fatigue was determined,

In zinc- and Q10-supplemented exercises: significance at the level of $p<0.05$ between pre-test fatigue and post-test rested was determined,

In zinc- and Q10-supplemented exercises: significance at the level of $p<0.01$ between pre-test fatigue and post-test fatigue was determined.

Table 5. *Haemoglobin value averages in players who participated into the research according to the groups and intergroup comparisons.*

Group	Pre-test rested	Pre-test fatigue	Post-test rested	Post-test fatigue
Zinc supplemented exercise	14.35 (13.30-15.42)^{A}	14.30 (12.85-14.87)^{AB}	14.90 (14.10-15.10)^{B}	14.65 (13.95-15.15)^{A}
Q 10 supplemented exercise	13.80 (13.62-14.22)^{A}	13.65 (13.35-14.42)^{AB}	14.25 (14.02-14.65)^{B}	14.15 (13.90-14.60)^{A}
Only exercise	14.30 (14.02-14.80)^{A}	14.55 (14.32-14.60)^{B}	14.20 (13.85-14.40)^{B}	14.70 (14.25-15.07)^{A}
Zinc and Q10 supplemented exercise	13.35 (12.87-14.27)^{A}	13.50(12.55-13.77)^{A}	13.30 (12.57-13.80)^{A}	13.75 (13.52-14.22)^{A}

In pre-test fatigue, significance at the level of $p<0.05$ between only exercise and zinc- and Q10-supplemented exercise was determined (Table 5),

In post-test rested, significance at the level of $p<0.05$ between zinc- and Q10-supplemented exercise and only exercise, Q10-supplemented exercise and zinc-supplemented exercise was determined.

Discussion and Conclusion

It was noticed that the effect of exercise upon some blood parameters was investigated in some studies in the literature. One of these was carried out by Kappel et al. upon sedentary experiments, and they determined increase at leucocyte values during the exercise and after the exercise [13]. Similarly, Katsuhiko et al. found significant increases at total leucocyte numbers and leucocyte rate in 32 year-old marathon athletes at the end of acute measurements performed after 1999 Beppu-

Oita Mainichi marathon [14]. We understood from these studies that whether sedentary or an active player, the number of leucocyte increased with exercise. Monya et al. who studied on this performed sub-maximal exercises to players and sedentary males, and found leucocyte increase of the sedentary players as significant [15]. The exercises in the studies varied. Ozdengil administered a 50 pedal/min loading with max VO_2 at 60% severity for 60 minutes to the individuals in their study they carried out on sedentary individuals, and found significant increases in leucocyte numbers [16]. Acute sub-maximal exercise was indicated to significantly increase leucocyte numbers more rather than the pre-exercise values, and these increases was concluded to be dependent upon plasma losses created by the exercises. Short-term exercise performed until fatigue was suggested to increase leucocyte numbers, this could not only be explained through homo-concentration mechanism, and could be related to metabolic changes occurred during the exercise [17]. Similarly, it was also revealed that acute sub-maximal exercise increased leucocytic parameters, and this increase was correlated with the intensiveness of the exercise [18].

In the literature, effects of exercise upon the number of erythrocyte was also investigated, and results different from each other were obtained. In the study carried out by Gren et al. upon sedentary experiments, more significant increases in RBC values were noticed in exercise programs longer than 4 weeks rather than the values in the beginning [19]. The result of our study also supported this finding. In contrast, at the end of 5-week training programs performed to 16 male and 8 female judoists by Su et al. decrease at RBC values was determined [20]. The reason for this decrease was considered to be related with intensity of loading or the altitude above sea level in the area where the trainings were performed. In the study carried out by Senturk et al. upon investigated whether being sedentary or a player affected RBC values at the end of the exercises, no significant differences were specified in RBC levels [21]. The difference of this study from the others was exercise period's being 2 weeks. For that reason, it was understood that exercise should be performed for more than 4 weeks in order to affect RBC number. Intensity of the exercise could be important upon affecting the level of RBC. At the end of 4 week intensive trainings performed by Halson et al. insignificant decreased were found in RBC number [22]. It was also reported that decrease at RBC number was possible to affect performance negatively depending upon the long-term exercises [23]. However, obtained findings' being within normal health limits could be considered as positive.

Like RBC, Htc value was also predicted to be affected from exercise, and various studies were carried out on this. Mashiko et al. indicated that 20 day camping period of 25 players did not create a significant change in Htc levels [24]. Six-week high-intensity interval training supporting these studies was determined not to create a significant increase at Htc level [19]. Su et al. noticed decrease at Htc values at the end of a 5-week training program performed to 16 male and 8 female judoists [20]. In some other studies carried out upon investigating the effects of various exercises upon Htc in various experiment profiles, significant increases were also obtained. As result of 8-week aerobic exercise administered by Unal and 6-week moderate exercise administered by Ersiz et al. significant increases were also found in Htc levels at the end of acute exercise programs administered to 32 year old males [25,26]. After 20-day chronic exercise performed to 10 players, significant increases at Htc values were determined [27].

In the study carried out by Rietjens et al. upon 11 (7 males, 4 females) Olympic athletes, blood samples were taken from the experiments before and after the session, and no significant changes were observed in MCV, MCH and MCHC parameters [28]. Similarly, Pouramir et al. determined no significant changes in MCV, MCH and MCHC levels of 35 male gymnasts' blood samples taken before and after the 10 week exercise program [29]. The MCV, MCH and MCHC levels determined in other studies were all within normal MCV, MCH, MCHC normal changing limits reported for human [30]. In their study upon 22 professional football players, Younesan et al. did not determine a significant different in MCV levels according to the blood samples taken before and after a 90-minute football match [31]. Differently, in their study upon marathon runners, Davidson et al. found increases at MCH values and decreases at MCV values at the end of the competition [32]. In their study upon marathon runners, Kratz et al. reported that MCV, MCH and MCHC values increased significantly at the end of marathon running [33]. When the hematologic findings obtained at the end of the study were suggested in several researches; and the increase noticed in hematologic parameters as result of both post-acute and chronic exercise could be explained through sympathetic nerve activity and hemo-concentration mechanism.

There were also studies investigating the relationship between exercise and thrombocyte in the literature. Unal could not find significant difference at Plt levels at the end of 8-week chronic aerobic exercise [25]. After high-intensity exercise, several changes in metabolism appear. Furthermore, it has also been revealed by various researchers that increases at Plt number occurred after acute maximal exercise; and this increase caused changes in some immunologic and hematologic parameters [2]. It was also suggested that thrombocyte levels increased and bleeding and coagulation periods decreased subsequent to acute sub-maximal exercise. Although these changes in hematologic parameters were noticed soon after the exercise, these changes were reported to turn back to resting level within 24 hours subsequent to exercise [18]. The significant increase obtained at post-training Plt levels could be explained with exercise-induced homo-concentration [30].

Significant change in Hb parameters was not present in any groups in our study. Similar to the results of our study, in his study, Bezci did not determine a significant difference in Hb levels of male taekwondo players. In their study upon 2-week normal training and subsequent 4-week intensive training [1], Halson et al. found rhythmic and insignificant decreases in Hb parameters in the first, second and third weeks, and significant regular and significant increases in the fourth, fifth and sixth weeks [22]. In their study upon marathon players, Davidson et al. found increases in Hb values after the competition rather than the values before the competition [32]. Karvonen et al. investigated Hb and Htc values before and after 25-km running, and found these values to be increased after the exercise [34]. When chronic exercise was administered to the sedentary experiments, increases at Hb values were possible to be noticed [35]. Subsequent to the trainings, increase at Hb amount was noticed, and this increase was reported to be arisen from the increase in blood volume [36].

In their study, Atan et al. could not find significance in aerobic and anaerobic pre-exercise and post-exercise (1 hour) MPV values [37]. We, in our study, noticed that administered zinc and CoQ10 with zinc supplements increased MPV. In general, high MPV in situations when Plt destruction increased caused considering that administered supplements could increase Plt destruction. Detailed additional study on this could be planned.

No significant change in our RDW and PDW parameters were determined. As similar to our study, in their study, Atan et al. found no significance in aerobic and anaerobic pre-exercise and post-exercise RDW and PDW values (1 h) [37]. In their study upon hematologic profile of Serbian Young National Football Teams, Stanković et al. determined PDW values as minimum 12.900 and maximum 15.600, and average value as 14.376 [38].

Iri mentioned in his study upon wrestlers that endurance workouts and heavy exercises were efficient upon zinc, calcium, magnesium, iron and copper levels [39]. It was determined in a similar study that zinc loading increased muscle strength and lactic acid sensitivity [40].

Consequently, some increase at leucocyte (WBC) values was noticed between the pre-test and post-test. Noticing this increase in all test groups included in our research meant that this aforementioned increase was not dependent upon the supplementary products (Zinc, CoQ10). The increase at leucocyte values was correlated with reaction and adaptation mechanism the body revealed during the exercising.

No significant difference was observed in MCV, MCH, MCHC and Hb values. However, a significant increase at MCV values was noticed to appear in groups administered with a supplement. This administered supplement could be considered as increasing the performance of individuals through the oxygen capacity. Noticing more increase in Htc values in post-tests rather than the pre-tests and also observing this increase in all control groups was considered to appear as a reaction not to the supplementary products but to the increase at physical stress-exercise capacity. Furthermore, this was considered to be arisen from dehydration that was possible to appear during the exercise and subsequent homo-concentration. No significant difference was determined in Hb value during the test. Under normal conditions (doing exercise on ideal time, ideal number, and ideal intensity) the change expected in players after the exercise was having higher Hb and Htc values rather than the sedentary individuals had. In our research, Hb value's not being significantly different was considered to be arisen from test period's being short (8 weeks) and exercise program's having low intensity. When the data we obtained at the end of the research we carried out were considered, it was concluded that zinc and CoQ10 supplements did not create a significant difference upon the physiologic values in individuals who were administered with short-medium term and heavily intensified exercise program. We predicted that higher performances in players administered with zinc and CoQ10 supplement were possible to be obtained through longer training programs. Further studies in which performances of the players could be evaluated by the participation of more participants have been required.

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