THE SYNERGIC EFFECTS OF COENZYMEL0 AND CREATINE THROUGH ORAL INTAKE ON REPETITIVE SHORT DURATION HIGH-INTENSITY EXERCISE

SHOTA YASUKAWA1), YOSHIHARU FUJIEDA1), KENSUKE SAKAI2), KATSUMI SUGIURA2), MASASHI MORIFUJI2), CHIAMI SANBONGI2), HISATAKA ANBE1), RYOHEI ISAKU1), MASASHI KAWAGUCHI1), KENICHI SUIO1) and KAZUKI SUMI1)

Abstract
A double-blind placebo-controlled trial was undertaken to evaluate the synergic effects of coenzymeQ10(CoQ10) and creatine(Cr) through oral supplementation on the intermittent short duration high-intensity exercise on a cycle ergometer. Twenty-eight male athletes were divided into four groups of CoQ10 and Cr(CoQ10 + Cr), CoQ10(CoQ10 + Pi), Cr(Pi + Cr) and placebo group(Pi + Pi). Each participant was instructed to take 100 mg of CoQ10 and/or 5 g of Cr per day for 2 weeks. Repetitive 5 bouts of 10-sec high-intensity cycle exercise tests were performed before and after supplemenations. After supplemenations, subjects in CoQ10 + Cr revealed most improved performance in mean power outputs at the 2nd (p<0.05) and the 3rd (p<0.05), the 4th (p<0.05) and the 5th set (p=0.06) comparing with the participants in the other 3 groups. These findings suggest that enhanced mean power output on repetitive short duration high-intensity exercise can be acquired after supplementing CoQ10 combined with Cr.

key word: coenzymeQ10, creatine, phosphocreatine, short duration high-intensity exercise

INTRODUCTION
CoenzymeQ10(CoQ10) is contained in mitochondria and has an important role in aerobic energy production and metabolism1), so that supplementation CoQ10 may enhance aerobic exercise. Although CoQ10 supplementation has been adopted in patients with chronic obstructive pulmonary disease, idiopathic pulmonary fibrosis1) and cardiovascular diseases5), it has not been popular among athletes as an ergogenic supplement like Creatine(Cr). Cr supplementation enhances short duration high-intensity exercise2,3) derived from increase of muscle phosphocreatine(PCr)2) and of PCr resynthesis rate in recovery phase after exercise2). Based on a hypothesis that muscle PCr resynthesis could be improved by Cr and CoQ10, in this study we investigated the synergic effects of oral supplementing Cr and CoQ10 on repetitive short duration high-intensity exercise.

METHODS
Subjects: Twenty-eight male athletes participated in this study. Prior to the intervention, all subjects were fully informed of the outline of the procedures and signed a written consent form. After matching age, body height, weight and mode of sport activities they had been engaged in, subjects were divided into four groups, CoQ10 and Cr(CoQ10 + Cr; n = 7), only CoQ10(CoQ10 + Pi; n = 7), only Cr(Pi + Cr; n = 7) and placebo group(Pi + Pi; n = 7). For the purpose of ensuring safety and checking up side effects from supplementing, we examined blood chemical analysis at baseline and the day 14th.

Supplementation: We carried out this experiment in a double-blind placebo-controlled trial. All the subjects were instructed to take 100 mg of capsules CoQ10 or its placebo with a glass of water at breakfast. Similarly they were asked to take 5 g of pow-
derry Cr or its placebo with a glass of 100% orange juice. We adopted capped olive oil and maltodextrin powder as placebos. Supplementation were performed through continuing 14 days.

Procedures; Subjects underwent high-intensity intermittent exercises of repetitive 5 time bouts on a cycle ergometer twice at baseline and the day 14th. This intermittent exercise testing was composed of 5 bouts of 10 sec. high-intensity exercise at the load of 7.5% body weight (kg) and 5 min. intervals with each other. Subjects were requested to give their maximal effort through a sequence of high-intensity and short duration cycling. We employed the mean power output as an index of this test performance.

Statistics; Results are expressed as means ± standard deviations. Two - way analysis of variance (ANOVA) used to examine differences among the groups. Wilcoxon’s signed rank test was adopted within each trial. Statistical significance was accepted at the 0.05 level and statistical tendency was accepted at the 0.1 level.

RESULTS

Blood CoQ10 and Cr concentration; Table 1 illustrates the blood CoQ10 and Cr concentration, before and after supplementing period. The (CoQ10 + Pi; 278.72 ± 101.10 to 857.51 ± 741.39 ng/ml, p < 0.05) and the (CoQ10 + Cr; 306.49 ± 91.57 to 890.02 ± 369.58 ng/ml, p < 0.05) increased blood CoQ10 concentration. The (Pi + Cr; 0.41 ± 0.23 to 9.21 ± 7.85 mg/dl, p < 0.05) and the (CoQ10 + Cr; 0.33 ± 0.19 to 8.18 ± 6.78 mg/dl, p < 0.05) also revealed elevated Cr levels in blood.

Exercise performance; Two - way ANOVA did not showed any statistical distinctions in 4 different patterns of intake with each other. However, Wilcoxon’s signed rank test demonstrated an improvement of mean power output within each trial after the interventions. After the supplementing period, the (Pi + Pi) improved mean power outputs at the 1st (656 ± 83 to 692 ± 83 watts, p < 0.05) and the 3rd (674 ± 88 to 693 ± 87 watts, p < 0.05). As to the (Pi + Cr) and (CoQ10 + Pi), similarly increased mean power outputs were observed at the 2nd (682 ± 67 to 711 ± 49 watts, p < 0.05) the 3rd (668 ± 58 to 699 ± 76 watts, p < 0.05) and the 4th set (651 ± 59 to 688 ± 84 watts, p < 0.05) of the former, and at the 2nd (701 ± 129 to 713 ± 121 watts, p < 0.05), the 3rd (688 ± 129 to 704 ± 124 watts, p < 0.05) and the 4th (669 ± 110 to 691 ± 121 watts, p < 0.05) of the latter respectively. The (CoQ10 + Cr) demonstrated the best improvement than any other 3 different pattern of supplemental combinations. Statistically consecutive enhancements of mean power output were recognized at the 2nd (691 ± 88 to 723 ± 71 watts, p < 0.05), the 3rd (671 ± 88 to 702 ± 71 watts, p < 0.05), the 4th (656 ± 84 to 677 ± 76 watts, p < 0.05) and the 5th (636 ± 79 to 663 ± 74 watts, p = 0.06). Figure 1 illustrates mean power outputs of the (CoQ10 + Cr) before and after supplementing period.

DISCUSSION

CoQ10 and Cr concentrations in blood; Nielsen AN, et al. reported that 100 mg CoQ10 per day for 6 weeks

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<tr>
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<th>CoQ10 (ng/ml)</th>
<th>Cr (mg/dl)</th>
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<tr>
<td></td>
<td>Baseline</td>
<td>After 14 days</td>
</tr>
<tr>
<td>Pi + Pi</td>
<td>208.0 ± 84.6</td>
<td>284.4 ± 93.1</td>
</tr>
<tr>
<td>CoQ10 + Pi</td>
<td>278.7 ± 101.1</td>
<td>857.5 ± 741.4</td>
</tr>
<tr>
<td>Pi + Cr</td>
<td>335.9 ± 151.4</td>
<td>302.7 ± 57.2</td>
</tr>
<tr>
<td>CoQ10 + Cr</td>
<td>306.5 ± 91.6</td>
<td>890.0 ± 369.6</td>
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(n = 7, respectively)
increased blood CoQ10 concentrations significantly\(^6\). In this study, 100 mg of CoQ10 on a daily basis for 14 consecutive days revealed a similar result as Nielson had mentioned. Jesus Rico-Sans presented that a daily dose of 5 g Cr for 9 and 11 days increased muscle PCR significantly\(^7\). Significantly elevated blood Cr concentrations that might induce increased PCR in muscle were observed in our subjects.

**Blood chemical analysis**: As far as I looked in previous studies on the side effects derived form CoQ10 and Cr, obvious described disorders in liver and kidney functions derived form CoQ10 and Cr could not be found. However, to enhance the safety for our participants, we employed blood chemical analysis to check up conditions in liver and kidney functions, adopting the parameters of glutamic-oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), lactate dehydrogenase (LDH), blood urea nitrogen (BUN), and creatinine (CRE). All readings of these parameters located within normal range not only at baseline but also post supplementing.

**Exercise performance**: In our experiment, the (CoQ10+Cr) revealed drastic enhancement of mean power output on repetitive high-intensity exercise, comparing with the other 3 sub-groups. Kurosawa et al. proposed that 30 g Cr per day for 14 days improved mean power output and adenosine triphosphate (ATP) synthesis through PCR hydrolysis during 10 sec. maximal handgrip exercise with a handgrip ergometer\(^10\). Balsom PD et al. indicated the muscle Cr and PCR concentrations after five 6 sec. bouts of high-intensity exercise on cycle ergometer were increased by 20 g Cr monohydrate day\(^{-1}\) for 6 days in laboratory\(^9\), and Oyama et al. insisted that using the same protocol supplementation as Balsom could prevent performance lowering of 5 bouts of 60 m sprint running in filed environment and sprint cycling for 7 sec. with maximal effort in laboratory\(^9\). Fokkers K. et al. reported that CoQ10 is contained in mitochondria and has an important role in aerobic energy production and metabolism\(^5\). Patients with chronic lung disease revealed aerobic exercise performance tended to increase by CoQ10 oral administration of 90 mg per day for 8 weeks\(^4\). Taking these previous reports and our results into
consideration, we speculated that maximal exercise for 10 sec. depends on not only anaerobic ATP-CP metabolism but also aerobic ATP synthesis depending mitochondrial metabolism.

**CONCLUSION**

This investigation suggests that enhanced mean power output on repetitive short duration high-intensity exercise could be acquired by the synergic effects of CoenzymeQ10 and Creatine supplementation without side effects in blood chemical analysis.

**REFERENCES**


