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Coenzyme Q10 Forte product influence on muscle soreness and muscle fatigue sensation, in acute intense physical stress

Influenţa produsului Coenzima Q10 forte, asupra senzaţiei de durere musculară şi de oboseală musculară, în stresul fizic acut intens

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Abstract

Background. Fatigue is associated with low levels of Coenzyme Q10 (CQ10).

Objectives. The objective is to highlight the influence of the Coenzyme Q10 Forte product (CoQ12F) on muscle soreness sensation (MSS) and muscle fatigue sensation (MFS), in acute intense physical stress.

Methods. The selected subjects (n=42 men) were randomly divided into two groups, who received: placebo (P=21) and CoQ10F (CoQ=21), for 21 days before the physical stress. Stress was represented by physical exercise, carried out on a Excite+ Run MD treadmill, 240 watt. The following were analyzed: MSR, using the 100 mm visual analogue scale; and MFS, using the 5-point Likert scale. Statistical evaluation was made on the basis of Student test.

Results. Parameters, in CoQ compared to P, were significantly reduced immediately after the stress: MSS (p=0.01) and MFS (p=0.002). There were differences in the dynamic developments between CoQ and P groups, for both parameters. CoQ10F influence was more intense on MSS than on MFS, immediately post-stress.

Conclusions. 1) Under CoQ10F influence, compared to P, MSS and MFS were reduced after the stress. 2) CoQ10F influence was higher immediately post-stress for MSS and after 24 h, for MFS. 3) Due to these effects, CoQ10F could be largely used in acute intense physical stress in order to decrease muscle soreness sensation and muscle fatigue sensation. 4) Further studies of CoQ10F would be required to bring additional details in this direction.

Key words: coenzyme Q10, physical stress, muscle soreness, muscle fatigue.

Rezumat

Introducere. Obosela este asociată cu niveluri scăzute de coenzimă Q10 (CoQ10).

Obiective. Obiectivul este evdenţierea influenţei produsului Coenzima Q10 Forte (CoQ12F), asupra senzaţiei de durere musculară (SDM) şi senzaţiei de oboseală musculară (SOM), în stresul fizic intens acut.

Metode. Subiecţii aleși (n=42 bărbaţi) au fost împărţiţi randomizat în două grupuri, care au primit: placebo (P=21) şi CoQ10F (CoQ-21), pentru 21 zile înainte de stresul fizic. Stresul a foat reprezentat de un efort fizic, realizat pe un covor rulant Excite+ Run MD treadmill, la 240Watt. Au fost evaluate: SDM, utilizând scara vizuală analogă de 100 mm şi SOM, utilizând chestionarul stării de oboseală al scalei Likert, cu 5 puncte. Evaluarea statistică s-a făcut pe baza testului Student.

Rezultate. La CoQ, comparativ cu P, parametrii au fost semnificativ reduşi, imediat după stres: SDM (p=0,01) şi SOM (p=0,002). Au existat diferenţe între CoQ şi P, în evoluţia dinamică a ambilor parametri. Influenţa CoQ10F a fost mai intensă asupra SDM decât asupra SOM, imediat după stres.

Concluzii. 1) Sub influenţa CoQ10F, comparativ cuP, SDM şi SOM au fost reduse după stres. 2) Influenţa CoQ10F a fost mai mare imediat după stres. 3) Datorită acestor efecte, CoQ10F ar putea fi utilizată în stresul fizic acut, cu scopul de a reduce senzaţia de durere musculară şi senzaţia de oboseală musculară. 4) Studii viitoare referitoare la CoQ10F ar fi necesare, pentru a aduce detalii suplimentare în această direcţie.

Cuvinte cheie: coenzima Q10, stres fizic, durere musculară, oboseală musculară.

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Introduction

a) Physical exercise-induced muscle soreness and muscle fatigue

Intense exercise has multiple consequences, including muscle soreness and muscle fatigue. Muscle soreness usually occurs after intense training or exercise that involves a large amount of muscle contractions (Wessel & Wan, 1994; Gulick, Kimura, 1996; Clarkson, Hubal, 2002). Muscle fatigue is described by Gandevia as an "exercise-induced reduction in maximal voluntary muscle force. It may arise not only because of peripheral changes at the level of the muscle, but also because the central nervous system fails to drive the motoneurons adequately" (Gandevia, 2001).

b) Coenzyme Q10 (CoQ10)

The history of CoQ10 starts with the two discoveries made in 1957, one by Crane, who first isolated CoQ10 from beef heart mitochondria (Crane et al., 1989), and the other by Morton, who defined a compound obtained from vitamin A deficient rat liver that he called ubiquinone, which is the same as CoQ10 (Morton et al., 1957). 21 years later, in 1978, Peter Mitchell was awarded the Nobel Prize for the vital protonmotive role of CoQ10 in energy transfer systems (Mitchell, 1991). CoQ10 has a key role in mitochondrial bioenergetics (Littarru & Tiano, 2007; Bergamini et al., 2012; Garrido-Maraver et al., 2014a; Garrido-Maraver et al., 2014b) and its increased body consumption is the presumed cause of low blood CoQ10 levels.

c) CoQ10 supplementation and physical exercise

Intense physical exercise is one of the situations of increased CoQ10 utilization. A study carried out in 2007 shows that ”CoQ10 has an influence on effort capacity trough its energetic function, antioxidant role and influence in cardiovascular adaptation” (Ciocoi-Pop RD, Tache S, 2007). A recent study states that ”fatigue is often described by patients as a lack of energy, mental or physical tiredness after physical activity and it is associated with low levels of CoQ10” (Filler et al., 2014). Effects of oral CoQ10 supplementation have been observed in "positive clinical and haemodynamic double-blind trials" (Overvad et al., 1999). A research in 2008 concluded that "acute and chronic supplementation of CoQ10 may affect acute and/or chronic responses to various types of exercise" (Cooke et al., 2008).

Many studies concerning the relationship between physical exercise and CoQ10 have taken into consideration the medical or the oxidative stress evaluation, and less the psychological evaluation. The present article continues a previous research of the authors concerning the psychological assessment of the relationship between physical exercise and CoQ10 (Jurcău & Jurcău, 2014).

Hypothesis

Although CoQ10 supplementation is used in exercise, little is known about its influence on muscle soreness sensation (MSS) and muscle fatigue sensation (MFS) in acute physical exercise.

Objective

The objective is to highlight the influence of the *Coenzyme Q10 Forte* product (CoQ12F) on MSS and MFS in acute intense physical stress.

Material and methods

Research protocol

a) Period and place of the research

In conformity with the Helsinki Declaration, the Amsterdam Protocol and Directive 86/609/EEC, the study was approved by the Ethics Commission of the College of Physicians, Cluj County, Romania (No. 1045/ 09.05.2013). The study and the measurements were carried out between March and May 2014, in the Medical Family Office 122 in Cluj-Napoca.

b) Subjects and groups

42 voluntary male subjects were selected. The selected subjects were sedentary. Persons with mental disorders, cortisone therapies of any kind and toxic addiction - alcohol, tobacco, drugs, coffee were excluded from the trials. The participants were randomly assigned to one of the two groups: a) the first group received placebo = P; b) the second group received CoQ10F = CoQ. The main characteristics of the participants were: number of subjects - 21 (P); 21 (CoQ); mean age – 21.3± 2 (P); 24.4±4 (CoQ). The two groups were subjected to the same type of physical exercise, on the treadmill.

c) Tests applied

- *Study design*

Method of exercise testing: before physical testing, each participant performed a 4-min muscle warm-up, on an Excite + Run MD treadmill, adjusted to 12 watts (W); after a 4-min break, the test was carried out on the same treadmill; physical exercise was started at a power output of 24 W, for 3 minutes, which was gradually increased by 24 W every 3 min, up to 240 W. The chosen preparation was "CoQ10 Forte" (CoQ10F), containing 100 mg CoQ10, produced by Dacia Plant company, Brasov, Romania (1). Both CoQ10F and P were administered for 21 days, 3 capsules a day, at 8.00-14.00-20.00, prior to the day on which the physical treadmill exercise test was initiated.

The evaluation time points for both P and CoQ were as follows:

time 2 = T2 - in the morning, before the exercise stress test, at 8.00 a.m.;

time 3 = T3 - 15 min after the exercise stress test;

time 4 = T4 - 24 hours after the exercise stress test.

- *Explorations*

The examined parameters were: muscle soreness sensation (MSS); muscle fatigue sensation (MFS). MSS: determined on the 100 mm visual analogue scale: 0 = no muscle soreness, 100 = impaired movement due to muscle soreness (Saunders et al., 2009). MFS: determined on the 5-point Likert scale - the participant placed a check mark in the specific box that correlated with their perceived level of fatigue: 1 - strongly disagree, 2 - disagree, 3 - neutral, 4 - agree, 5 - strongly agree (Likert, 1932; Norman, 2010).

d) Statistical processing

- The results obtained were analyzed using the SPSS 13.0. statistical package.
- For continuous data examination, the Student's t test was used.
- The differences were considered significant at a $p<0.05$.

Results

Note that the *reference time* was considered to be T_1.

a) Muscle soreness sensation (MSS) (Table I, Fig. 1). For P, compared to CoQ, MSS was significantly increased at T2 (p=0.05) and at T3 (p=0.005). At T2 compared to T1, MSS was increased significantly for P (p=0.03) and insignificantly for CoQ. There were significant differences between T1-T3, both for P (p=0.0001) and CoQ (p=0.01).

Table I. Changes of MSS in physical exercise.

Group	Mean	SD	SEM	p
T1P	24.6	15.2	3.317	0.03
T2P	40.6	17.2	3.753	
T1P	24.6	15.2	3.317	0.0001
T3P	70.1	31.2	6.806	
T1CoQ	28	17	3.71	0.01
T3CoQ	44.4	24.2	5.281	
T2P	40.6	17.2	3.753	0.05
T2CoQ	31	13.2	2.880	
T3P	70.1	31.2	6.806	0.005
T3CoQ	44.4	24.2	5.281	

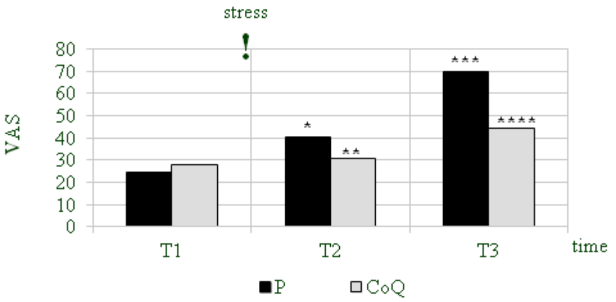

Fig. 1 – Changes of MSS in physical exercise
*p=0.03, **p=0.05, ***p=0.0001, ****p=0.005,
*= T2P-T1P, **= T2P-T2CoQ, ***= T3P-T1P, ****= T3P-T3CoQ
"stress" = time of acute and brief physical exercise

Table II. Changes of MFS in physical exercise

Group	Mean	SD	SEM	p
T1P	1.3	1.03	0.224	0.0001
T2P	5	3.1	0.676	
T1P	1.3	1.03	0.224	0.05
T3P	2	1.2	0.262	
T1CoQ	1.7	1.3	0.284	0.02
T2CoQ	3	2.1	0.458	
T2P	5	3.1	0.676	0.02
T2CoQ	3	2.1	0.458	
T3P	2	1.2	0.262	0.05
T3CoQ	1.3	1	0.218	

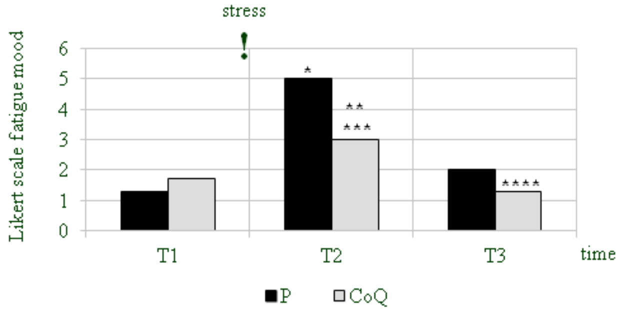

Fig. 2 – Changes of MFS in physical exercise
*p=0.0001, **p=0.02, ***p=0.02, ****p=0.05
*= T2P-T1P, **= T2CoQ-T1CoQ, ***= T2P-T2CoQ, ****= T3P-T3CoQ
"stress" = time of acute and brief physical exercise

b) Muscle fatigue sensation (MFS) (Table II, Fig. 2). For P, compared to CoQ, MFS was significantly increased at T2 (p=0.02) and T3 (p=0.05). At T2 compared to T1, MFS was significantly increased both for P (p=0.0001) and CoQ (p=0.02). There were differences between T1-T3: significant for P (p=0.05) and insignificant for CoQ.

c) Comparison between the influence of stress on MSS and MFS, at T2 and T3, by the P/CoQ ratio (Fig. 3). Influence of physical exercise: higher, but insignificant, on MFS (T2P/T2CoQ = 1.7) compared to MSS (T2P/T2CoQ = 1.3) at T2; almost equal on MSS (T3P/T3CoQ = 1.57) and MFS (T3P/T3CoQ = 1.53) at T3.

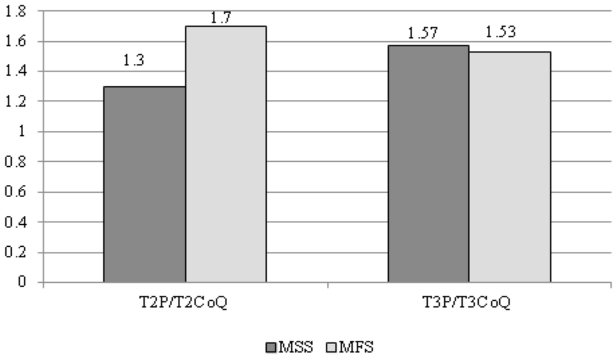

Fig. 3 – Comparison between the influence of stress on MSS and MFS at T2 and T3.

d) Comparison of the impact of CoQ10F on MSS and MFS, at T2 and T3 (Fig. 4). CoQ10F impact was higher, but insignificant: a) on MSS (T2CoQ/T1CoQ = 1.11) compared to MFS (T2CoQ/T1CoQ = 1.76) at T2; b) on MFS (T3CoQ/T1CoQ = 0.76) compared to MSS (T3CoQ/T1CoQ = 1.59) at T3.

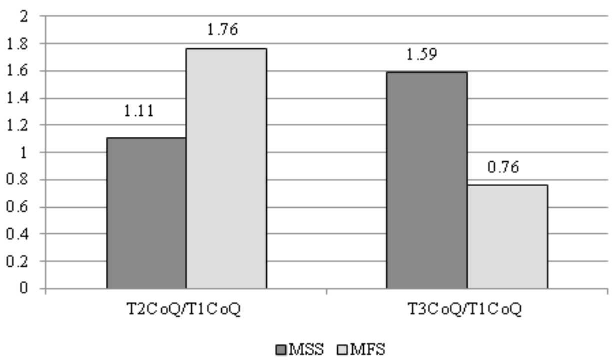

Fig. 4 – Comparison of the CoQ10F impact on MSS and MFS at T2 and T3.

Discussion

Muscle soreness and muscle fatigue in physical exercise. Chronological Pubmed evidence

For P, there were significantly elevated values: immediately after exercise (T2) for MFS (p=0.0001), and 24 h after stress (T3) for MSS (p=0.0001), which is in accordance with the results of several previous studies related to physical exercise. Thus, a 2010 study states that "exercise-induced muscle damage is associated with an acute-phase inflammatory response characterized by phagocyte infiltration into muscle" (Fatouros et al., 2010). This idea is also confirmed for "soccer training and soccer exercise", which is "associated with excessive production of free radicals" (Djordjevic et al., 2012). A recent research evidences that "physical training programmes are based on provoking transitory states of fatigue" (García Verazaluce et al., 2014).

CoQ10 and muscle soreness sensation. Chronological Pubmed evidence

CoQ10F had significant effects on MSS 24 h after physical stress, which was demonstrated by the significantly greater reduction in CoQ compared to P, mostly at T3 ($p=0.005$). These results obtained for the action of CoQ10F on MSS are similar to data from recent studies on the influence of CoQ10 on muscle soreness. Thus, the results of a study performed in 2007 suggested that "coenzyme Q10 supplementation may decrease muscle pain" (Caso et al., 2007). In 2011, it was shown that "patients with Fibromyalgia had statistically significant reduction on symptoms and clinical improvement after CoQ10 treatment" (Cordero et al., 2011). In the past two years, studies have found that "for the CoQ10 treated patients, the intensity of muscle pain decreased" (Fedacko et al., 2013) and that in the CoQ10 treated group "the intensity of muscle pain, measured as the Pain Severity Score (PSS), was reduced" (Skarlovnik et al., 2014).

CoQ10 and muscle fatigue sensation. Chronological Pubmed evidence

CoQ10F had the most significant influence on MFS, immediately after physical stress, which is evidenced by the significantly greater reduction in CoQ compared to P, at T2 ($p=0.02$). These results obtained for the action of CoQ10F on MFS are similar to data from recent studies on the effect of CoQ10 on fatigue sensation. Thus, a study in 2008 showed that "oral administration of CoQ10 improved subjective fatigue sensation and physical performance during fatigue-inducing workload trials and might prevent unfavorable conditions as a result of physical fatigue" (Mizuno et al., 2008). A research in 2010 reported that "fatigue indexes decreased with CoQ10 supplementation, but these decreases did not differ from that seen with placebo supplementation" (Gökbel et al., 2010), while in another study from the same year, it was found that "CoQ10 improves swimming endurance and has an antifatigue effect" (Fu et al., 2010). Two studies of 2014 confirmed this last statement, concluding that "the intake of Phlebodium decumanum plus coenzyme Q10, for 4 weeks, produced delaying fatigue" (García Verazaluce et al., 2014) and "oral CoQ10 plus NADH supplementation could confer benefits on fatigue in chronic fatigue syndrome" (Castro-Marrero et al., 2014).

CoQ10 supplementation and physical exercise. Chronological Pubmed evidence

By comparing the evolution of MSS and MFS throughout the study, it can be said that CoQ10F induced: a) muscle soreness protection more than muscle fatigue protection at T2, which is proved by the differences recorded immediately after physical stress (MSS-T2CoQ/T1CoQ=1.1; MFS- T2CoQ/T1CoQ=1.76); b) muscle fatigue protection more than muscle soreness protection at T3, which is demonstrated by the differences recorded 24 h after stress (MSS-T3CoQ/T1CoQ=1.59; MFS-T3CoQ/T1CoQ=0.76). These results obtained for the action of CoQ10F on the evolution of MSS and MFS throughout the study, are found in some previous studies. Thus, a research of 2009 shows that "CoQ10 supplementation increases maximum aerobic power in young trained soccer players" (Ciocoi-Pop RD, Tache S, Bondor C, 2009). Another study, in 2012, shows that CoQ10 supplementation had beneficial effects during exercise (Okudan et al., 2012). In the same year, it was shown that CoQ10 supplementation before strenuous exercise reduced subsequent muscle damage (Díaz-Castro et al., 2012). One year later, a research concluded that "untrained female mice that received antioxidants (α-lipoic acid, vitamin E and coenzyme Q10) performed significantly better than placebo-control mice" (Abadi et al., 2013).

The literature on CoQ10 related to muscle soreness sensation and muscle fatigue sensation is scarce. Through this study, we found the benefits of the CoQ10F product to reduce muscle soreness sensation and muscle fatigue sensation in acute intense physical exercise. Further studies are needed to provide additional details in this direction.

Conclusions

1. Under the influence of the CoQ10F product, compared to P, MSS and MFS were reduced after stress.
2. CoQ10F influence was higher immediately post-stress for MSS and after 24 h, for MFS.
3. Due to these effects, CoQ10F could be largely used in acute intense physical stress, in order to decrease muscle soreness sensation and muscle fatigue sensation.
4. Further studies on CoQ10F are needed to provide additional details in this direction.

Conflicts of interest

Nothing to declare.

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