Exercise performance and muscle contractile properties after creatine monohydrate supplementation in aerobic-anaerobic training rats

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Introduction

Recently, an increased number of scientists (Kamber M. et al.,1999) have investigated the potential benefit of creatine monohydrate (CM) as an ergogenic aid for improving exercise performance. CM supplementation first gained popular attention in the early 1990s after high profile Olympic athletes competing in sprint and power events at the Barcelona Olympic Games. Since this time creatine has become one of the most widely used nutritional supplements with an estimated worldwide consumption of 2.7 million kilograms (Williams M.H. et al., 1999). Most of the consumers of CM are among the power athletes, those with predominantly anaerobic working regimen of muscles. Harris R.C. et al. (1992) found out that phosphocreatine content in muscles can increase up to 50% following daily CM supplementation. Few studies have been performed on aerobic-anaerobic training subjects. The aim of this study was to examine the effects of creatine monohydrate supplementation of the diet on exercise performance and contractile variables in a mixed aerobic-anaerobic training regimen in rats.

Methods

20 male Sprague Dawley rats, 90 days old, were devided into creatine (Cr) and control (K) groups. The Cr-group received creatine monohydrate as a supplement to the diet, and the K-group received placebo. Both groups were trained 6 days a week on a treadmill for 20 days in a mixed (aerobic-anaerobic) metabolic working regimen (27 m/min, 15% elevation for 40 min). The exercise performance (sprint-test), contractile properties (m. tibialis anterior), oxidative enzyme activity (SDH, LDH, NADH2) in m. soleus and blood variables were assessed at the end of the trial.

Results

It was found out that the Cr-group demonstrated better sprinting performance than the rats of K-group (the Cr-rats reached higher velocity of the treadmill belt during the test - 79.00 ± 4.00 m/min vs. 67.00 ± 3.36 m/min, P<0.05). The initial twitch tension (F0) of m. tibialis anterior (containing predominantly types IIA and IIB muscle fibers) evocated by electrical stimulation, was higher in the Cr-group than in the control one (49.74±0.83 gf vs. 47.24±0.81 gf, P<0.05). The Cr-group achieved the maximum tension of this muscle during continuous stimulation (Fmax) later than the K-group (55.07±1.03 s vs. 45.54±0.93 s, P<0.001), and this Fmax was with higher values than in the controls (68.41±1.19 gf vs. 63.13±1.03 gf, P<0.01). The analysis of the m. tibialis anterior contraction curve following the continuous stimulation showed that the rats of Cr-group delayed the time to fatigue of this muscle when compared with the controls – it took the Cr-rats longer time to the moment of reducing their Fmax with 10%, 25%, and 50% when compared with the K-group (Figure 1). The decline of the strength contraction was analyzed in each 25th second from the beginning of the electrical stimulation up to the 450th second of this stimulation. On the second 100th, the strength of the evocated contraction was 94.04±0.62% of Fmax in the Cr-group, and 91.03±0.56% in the K-group (P<0.01), on the second 200th – 74.74±0.92% and 70.37±0.68% respectively (P<0.01), on the second 300th – 53.90±0.73% and 50.14±0.85% respectively (P<0.01), and on the second 400th – 32.34±0.86% and 26.34±0.58% respectively (P<0.001). A higher activity of LDH, SDH, and NADH2-cytochrome-c-reductase in m. soleus was found in Cr-group. No differences in the blood hematological and biochemical variables investigated were found out between the groups.

Conclusion

On the basis of the obtained results we conclude that the CM supplementation of the diet of doses 60 mg per day (an equivalent of 20 g for humans) improves the performance results, contractile properties of the fast twitch muscles, and increases the oxidative enzyme activity of aerobic-anaerobic trained rats.

References