Effect of β-alanine and Sodium Bicarbonate Supplementation, Separately and Combined, on High Intensity Cycling Capacity

Koivisto A1, Svendsen I1, Hem JE1-2, Raastad T1

1Olympiastadion, The Norwegian Olympic and Paralympic Committee and Confederation of Sports, Oslo, Norway
2Norwegian School of Sports Science, Oslo, Norway

There were no significant differences in watt production at any timepoint between β-alanine and placebo group. When β-alanine loading was combined with NaHCO₃ supplementation, there were no differences in W₅₀ in test 1, but the fall in watt production from test 1 to test 2 was significantly reduced (ΔW₅₀ = -4.7 ± 10 W (1.4 %) vs. -11.1 ± 16.2 W (3.9 %), p < 0.05) (figure 6).

Figure 2. Serum [lactate], [lactate] and [P] during repeated 5-minute cycle test after acute oral loading with sodium bicarbonate (NaHCO₃) or placebo.

Figure 3. Serum [lactate] during 5-minute cycle tests before and after β-alanine loading.

Figure 4. Mean power (W) during repeated 5-minute all out cycling test with NaHCO₃ and placebo.

Figure 5. Mean power (W) before and after 5-week β-alanine supplementation: during repeated 5-minute all out cycling test.

References


Introduction

During intensive muscular work the pH in muscle cells will drop depending on the intensity and duration of the exercise. Reduced pH in the muscle is associated with, among other things, the provision of muscle buffering capacity by up to 15% (Artioli et al. 2010, Derave et al. 2010).

β-alanine supplementation has the potential to elevate muscle carnosine and increase muscle buffering capacity by up to 6 g/d over 4 weeks (6 g/d)

Carnosine, a dipeptide that buffers hydrogen ions, is synthesized from glutamate and histidine and stored in skeletal muscle. Carnosine accumulation is associated with improved intra- and extracellular buffering capacity in sports leading to 5-10% improvement in performance. Supplementation with β-alanine can increase total plasma β-alanine concentration by up to 15% (Artioli et al. 2010, Derave et al. 2010).

Methods

Four physically active subjects were block randomized to either a placebo or β-alanine group (high dose 5 g·d⁻¹, low dose 3 g·d⁻¹). Effect size was estimated on the basis of power analysis (ΔW₅₀ = 10 W).

Results

There were no significant differences in VO₂max between placebo and β-alanine group at baseline (0.4 ± 0.4 ml·min⁻¹·kg⁻¹ vs. 0.4 ± 0.4 ml·min⁻¹·kg⁻¹). Significant differences were found in VO₂max after the 5-week loading phase (4.9 ± 0.4 ml·min⁻¹·kg⁻¹ vs. 6.1 ± 0.4 ml·min⁻¹·kg⁻¹). Twenty out of 28 recruited subjects completed the study. There was no difference in drop-out between placebo and β-alanine group. None of the subjects were following a vegetarian diet.

Blood analysis

Blood analysis showed that acute loading with sodium bicarbonate increased [s-NaHCO₃] ± s-base excess at all measured timepoints (figure 2). β-lactate was lower (13-20%) at all given timepoints (p < 0.05) except at baseline. Baseline β-lactate did not have an effect on s-base, but s-base was lower at 1 and 5 minutes after test 1 and test 2 compared to placebo (3). When β-alanine supplementation was combined with NaHCO₃, s-base was lower at test 1 (16%) and test 2 (20%) compared to β-alanine supplementation alone (p < 0.05).

Conclusion

Acute sodium bicarbonate loading (61±8 g·d⁻¹) did not affect 5-minute all out cycling performance. 5-week β-lactate loading (4g·d⁻¹) did not affect 5-minute all out cycling performances alone.

When chronic β-alanine supplementation was combined with acute sodium bicarbonate loading the fall in cycling capacity in the repeated performance test (with a 20 minute recovery time in between) was reduced by 25%.

Based on these results, it may be useful for athletes to combine sodium bicarbonate and β-alanine loading prior to competitions where repeated high intensity performance is required.

Figure 1. Study design.