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CURCA Center for Undergraduate Research and Creative Activities — University at Buffalo The State University of New York

The Effects of Beta-alanine Supplementation on the Aging Population

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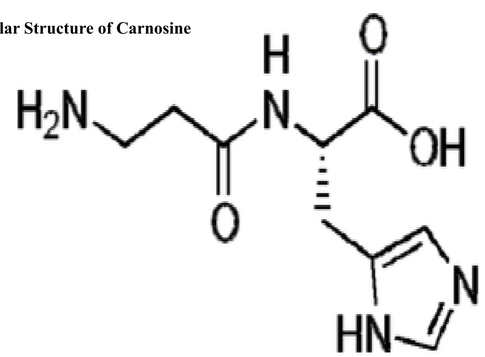
Abstract

β-Alanine (BA) supplementation has been shown to increase systemic carnosine levels possibly resulting in improved exercise duration and cognitive function.
PURPOSE: To determine if β-Alanine supplementation will improve cognitive function and exercise duration.
METHODS: 6 healthy men and women (age = 57.4 ± 7.8y) were randomized into a double blinded, parallel arm study. Subjects consumed 2.4g/d of β-alanine or Placebo for 28 days. Cognitive and physical assessments were performed prior to and after supplementation, including Stroop tests and an exercise bout on a cycle ergometer at 70% VO2 peak.
RESULTS: β-alanine supplemented subjects cycled longer than Placebo (7.9±1.4 vs 0.9±2.5 min, respectively, P<0.01). β-alanine supplementation eliminated the expected cognitive decline in Stroop Test time occurring after recovery from exercise testing.
CONCLUSION: Beta-alanine supplementation may lead to improved cognitive function and exercise duration.

Background

As we age, physical changes throughout the body are slowly occurring. Muscle is being replaced with fat resulting in notable decreases in exercise performance and duration. Significant atrophy of skeletal muscle as well as its replacement with fat has been seen to peak at around 50 years of age, a condition commonly known as sarcopenia. Directly coinciding with age related natural regression of skeletal muscle, intramuscular carnosine concentrations begin to deplete as well. Skeletal muscle is carnosine's most abundant storage source, so as a result of skeletal muscle regression, carnosine concentrations have been seen to drop by as much as 63% by age 70. Carnosine, in its active stored form, is a dipeptide synthesized from β-Alanine, the rate limiting factor, and L-histidine in a reaction catalyzed by carnosine synthetase. Supplementation with β-Alanine has shown to be an effective way to naturally increase and reverse depletion of carnosine stores. Carnosine has many intracellular functions including antioxidant and neuro-protective properties as well as sensitizing the sarcomere to calcium. However, its most notable function is its buffering capabilities. Interestingly, carnosine has also been found in notable concentrations within the human brain's cerebral areas and olfactory bulb.

Molecular Structure of Carnosine

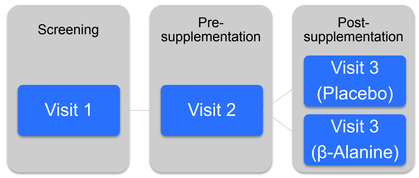


Aims

Aim 1: Increase systemic levels of carnosine through β-Alanine supplementation.
Aim 2: Increase cognitive function performance following submaximal exercise through an increase in systemic carnosine levels.
Aim 3: Increase submaximal exercise endurance time through an increase in systemic carnosine levels.

Methods

11 healthy adults over the age of 50 years were randomized into two groups for supplementation using a double blinded parallel arm experimental design. Subjects were given either a daily 2.4g of β-Alanine or Placebo for 28 days. Cognitive and physical assessments were performed pre and post-supplementation, which included the Stroop test, an exercise bout on a cycle ergometer at 70% VO2 to fatigue, and lactate measures both prior to and following exercise. During the exercise bout, VO2 was continuously measured via a Vacumed Metabolic Cart. Heart rate (HR), and Rate of Perceived Exertion (RPE) were recorded every two minutes.



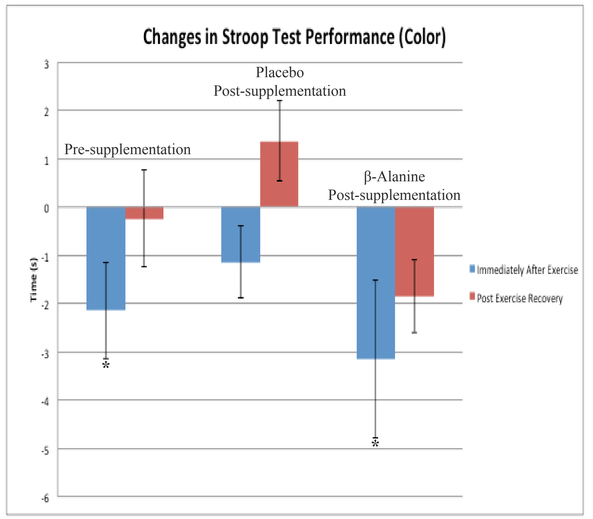
During screening (visit 1), subjects underwent body composition measurements, 4 Stroop tests, and a submaximal continuous graded peak test to derive each subject's 70% VO2 used as their workload for subsequent visits. Subjects performed 4 Stroop Tests at every visit, thus eliminating a familiarization factor in performance. Each Stroop test is scored based on accuracy and speed. After the pre-supplementation visit (visit 2), subjects received β-Alanine or Placebo and a supplementation plan to be followed in 2, 14 day blocks immediately following each other. Upon completion of 28 days of supplementation, subjects returned for their post-supplementation visit (visit 3) in which procedures from visit 2 will be repeated for comparison. Blood samples prior to and after supplementation were taken to be used for future testing. Data was analyzed using Two Way Repeated Measures ANOVA (SigmaPlot 13.0) with Bonferroni posthoc analysis at a P level of 0.05.

Stroop Test

Subject Demographics (n=11)	
Characteristics	Mean±SD
Age (yrs)	60.5±8.9
Height (m)	1.7±0.07
Weight (kg)	79.5±12.9
Body Fat (%)	22.4±10.1
Fat Free Mass (kg)	65.8±14.3
Body Mass Index	27.1±3.4
70% Peak Watts (watts)	111.2±30.7

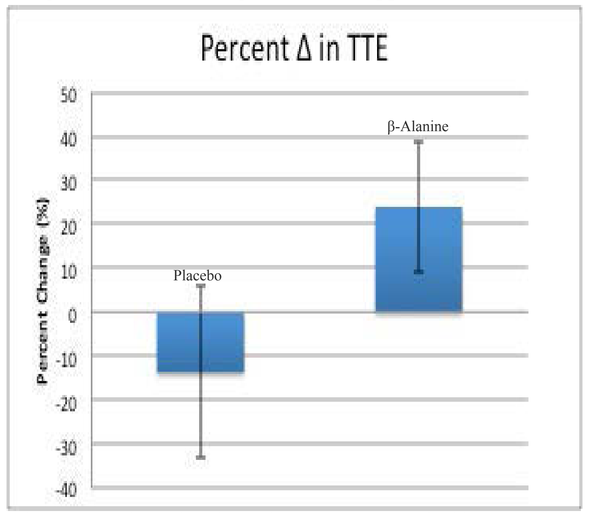
Results

Figure 1. Stroop Test Performance



Before supplementation, all subjects were able to improve Stroop test performance immediately following exercise fatigue (-2.1±1.0s, P<0.05). Following a 5 minute post-exercise recovery, subject's exhibited a cognitive decline. These results are an expected response to short duration submaximal exercise. After supplementation, the BA group improved Stroop test performance immediately following fatigue (-3.1±1.0s, P<0.05) while Placebo did not (-1.1±1.0s, P=0.3). The BA group was able to express a significant improvement in cognitive function immediately following exercise when compared to their pre-supplementation Stroop test performance. As we expected, controls showed no significant change from pre to post-supplementation Stroop test performance at any point in time.

Figure 2. Percent Change From Pre-supplementation TTE



There was no detectable change in TTE regardless of subject treatment, though change in TTE within the BA group trended towards significance (P<0.1). The BA group cycled 12.4±2.5mins while the Placebo group cycled 8.7±2.7mins.

Funding

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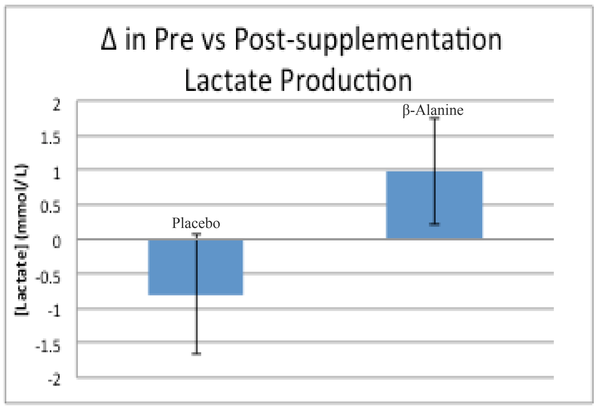
The study is being performed within the University at Buffalo's Horvath Nutrition and Human Performance Laboratory.

Figure 3. Pre vs Post-supplementation Lactate Production



Neither the BA group (19%) nor the Placebo group (-16%) produced a detectable change in lactate production during exercise. Though when comparing BA to Placebo, BA produced 2.9±0.6mmol/L more lactate post-supplementation (P<0.05).

Figure 4. BA Pre vs Post HR

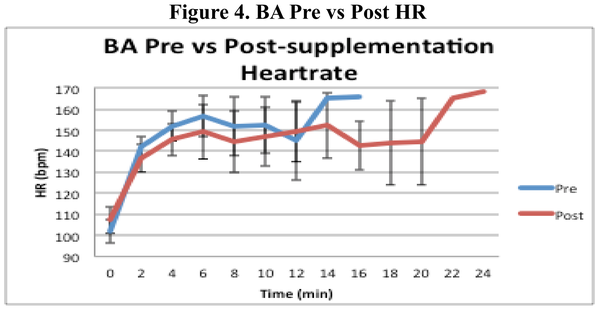


Figure 5. Placebo Pre vs Post

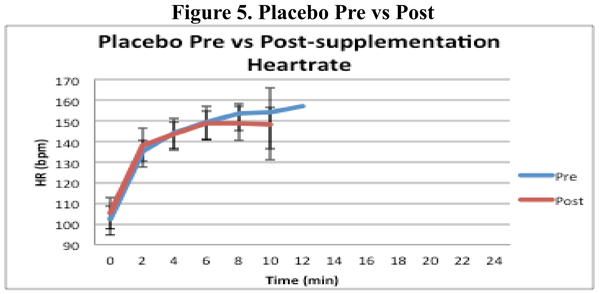


Fig. 4- There was no detectable difference between pre vs. post-supplementation HR in those receiving BA, but VO2 peak was higher after supplementation (data not shown, P<0.05). Therefore, subjects could have been exercising at a higher intensity.
Fig. 5- There was no detectable difference between pre vs. post-supplementation HR in those receiving Placebo.

Conclusion

Results have shown that 28-day β-Alanine supplementation may help to improve cognitive function immediately following endurance exercise fatigue in middle aged adults. The cause of improvement may be contributed to increased carnosine concentrations within the brain acting as an antioxidant and neuro-protective agent. Furthermore, β-Alanine supplementation seemed to improve TTE when compared to those on Placebo. However, significant changes in TTE as well as lactate production and HR were unable to be detected within either treatment. When comparing treatments, subjects supplemented with BA produced significantly more lactate than Placebo possibly as a result of a longer exercise duration and power output.