The Effects of Beta-alanine Supplementation on the Aging Population

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Background

As some may have already noticed, age is often associated with a normal decrease in exercise performance. As we age physical changes throughout the body are slowly occurring. Muscle is being replaced with fat leading to notable decreases in exercise performance, duration, and resistance to fatigue. Significant regression in muscle as well as its replacement with fat has been shown to peak at 50 years of age and is commonly known as sarcopenia [8]. Directly coinciding with an age related natural regression of skeletal muscle, intramuscular carnosine concentrations begin to deplete because skeletal muscle, specifically type I fibers, are carnosine’s most abundant storage source. As a result of depleting intracellular storage sites, carnosine levels have been seen to drop 63% by age 70 [4,9].

Carnosine has many intracellular functions, however its mainly protective, antioxidant, and exercise endurance enhancing abilities, is carnosine’s ability to increases the sensitivity of the sarcomere in both type I and II muscle fibers to Ca²⁺ released by the sarcoplasmic reticulum in response to stimuli leading to more efficient muscle contractions [7]. Also associated with carnosine’s exercise enhancing abilities, is carnosine’s ability to increase muscle fiber sensitivity to Ca²⁺ released by the sarcoplasmic reticulum in response to stimuli leading to more efficient muscle contractions [7]. Carnosine also exhibits neuro-protective capabilities such as containing antioxidant properties, and an ability to act as a free radical scavenger. These properties act to protect the body, including the brain, from free radicals and oxidative conditions during stress. Previous studies suggest these neuro-protective properties may be the mechanism behind improved cognitive function [2,6].

Mechanism of Action

Carnosine acts as an acid buffer to help maintain homeostatic pH levels within the body and has been seen to buffer up to 40% of the H⁺ produced during exercise [7]. Also associated with carnosine’s exercise enhancing abilities, is carnosine’s ability to increase muscle fiber sensitivity to Ca²⁺ released by the sarcoplasmic reticulum in response to stimuli leading to more efficient muscle contractions [7]. Carnosine also exhibits neuro-protective capabilities such as containing antioxidant properties, and an ability to act as a free radical scavenger. These properties act to protect the body, including the brain, from free radicals and oxidative conditions during stress. Previous studies suggest these neuro-protective properties may be the mechanism behind improved cognitive function [2,6].

Objective

Aim 1: Increase serum levels of carnosine through beta-alanine supplementation.
Aim 2: Increase submaximal exercise endurance time through an increase in serum carnosine levels.
Aim 3: Increase cognitive function performance during submaximal exercise through an increase in serum carnosine levels.

Method

Methods

During screening (visit 1), subjects will undergo body composition measurements, Stroop tests, and a ventilation test to establish a baseline for comparison. After the pre-supplementation visit, subjects will receive the beta-alanine or the placebo and follow the designed supplementation plan for 28 days. Upon completion of the supplementation subjects will return for their post-supplementation visit (visit 3) in which procedures from visit 2 will be repeated for comparison.

Blood samples prior to and after as well as a gas collection during exercise will be taken and analyzed to ensure carnosine has improved by exercising but buffering byproducts. Stroop tests will be scored on accuracy and speed. Stroop test and PWC results will be analyzed by observing trends within subject performance.

Anticipated Results

Upon completion of their 28 day supplementation schedule, we expect to see positive correlations between subject’s PWC results and Stroop tests scores from increased intracellular carnosine concentrations. With more carnosine, the body will be more effective at buffering fatigue inducing byproducts of metabolism allowing longer, more intense exercise. The increased carnosine may also exhibit increased neuro-protective, antioxidant, and free radical capabilities leading to improved Stroop tests scores and therefore cognitive function.

Discussion

Results from this study could be beneficial to the aging population. Improving exercise capacity and cognitive function through nutritional supplementation could be an effective, yet safe way to improve quality of life. Increasing the ability to resist fatigue, increasing exercise durations and intensities, will decrease the likely hood of discontinuing newly started exercise programs, leading to healthier individuals. Improving cognitive function may help individuals to excel in reaction time and mental effort of tasks, leading to improved work and home quality of life.

Molecular Structure of Carnosine

Figure taken from Collection 1111, et al. [2,6]

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