Effects of Supplemental Citrulline Malate Ingestion During Repeated Bouts of Lower-Body Exercise in Advanced Weightlifters

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Abstract

Wax, B, Kavazis, AN, Weldon, K, and Sperlak, J. Effects of supplemental citrulline malate ingestion during repeated bouts of lower-body exercise in advanced weightlifters. *J Strength Cond Res* 29(3): 786–792, 2015–The purpose of this investigation was to test the efficacy of citrulline malate supplementation on exercise performance, blood lactate, heart rate, and blood pressure during lower-body dynamic resistance exercise. We hypothesized that citrulline malate ingestion before performing submaximal repeated bouts of multiple lower-body resistance exercises would improve performance. Twelve advanced resistance-trained male subjects participated in a randomized, counterbalanced, double-blind study. Subjects were randomly assigned to placebo (PL) or citrulline malate (8 g) groups and then performed repeated bouts of multiple lower-body resistance exercise. Specifically, subjects performed 5 sequential sets (60% 1 repetition maximum) to failure on the leg press, hack squat, and leg extension machines. Blood lactate, heart rate, systolic blood pressure, and diastolic blood pressure were determined before and after exercise. The exercise protocol resulted in sequential significant ($p \leq 0.05$) decrease in the number of repetitions in all 3 exercises. However, subjects in the citrulline malate group performed significantly ($p \leq 0.05$) higher number of repetitions during all 3 exercises compared with PL group. Blood lactate and heart rate were significantly increased ($p \leq 0.05$) after exercise compared with before exercise but were not significantly different between citrulline malate and PL ($p > 0.05$). No significant ($p > 0.05$) differences were detected for blood pressure measurements. In conclusion, our results suggest that citrulline malate supplementation may be beneficial in improving exercise performance during lower-body multiple-bout resistance exercise in advanced resistance-trained men.

Key Words ergogenic aids, supplement, weight training, fatigue, anaerobic exercise

Introduction

In the competitive arena of sports, athletes are continuously seeking training aids and supplements that may provide them with a competitive edge. Exogenous substances that increase athletic performance (i.e., enhanced muscular power, strength, and endurance) are referred to as ergogenics (37). Recently, studies reported that an over-the-counter supplement named citrulline malate enhanced aerobic energy production (5), augmented muscular force output (27), and mitigated muscle fatigue (5).

In this regard, citrulline malate (brand name Stimol) was originally developed to improve the muscle performance of patients suffering from asthenia and to improve recovery time from physical activity for individuals with acute diseases (11). Citrulline malate is made of L-citrulline and malate. L-citrulline is a nonessential amino acid produced endogenously in the body through 2 key metabolic processes. First, L-citrulline can be synthesized in the intestinal tract from the amino acid glutamine. Also, L-citrulline can be synthesized from the conversion of L-arginine to nitric oxide in a reaction catalyzed by nitric oxide synthase enzymes (31). Importantly, oral L-citrulline, unlike oral L-arginine, bypasses the hepatic metabolism and is not catabolized by arginase enzymes, thus allowing it to be transported to the kidneys where approximately 80% of L-citrulline is converted into plasma arginine by the cells of the proximal tubules (32). Specifically, research has shown that L-citrulline supplementation augments plasma L-arginine concentrations (19), accelerates the clearance of plasma lactate and ammonium through urea cycle, thereby contributing to improved muscle function (8,16,33). Malate is an intermediate of tricarboxylic acid cycle (TCA) and its supplementation may augment energy production (5,34). The beneficial effects of citrulline malate may actually be attributed to the synergistic combination of both L-citrulline and malate at the muscles'

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