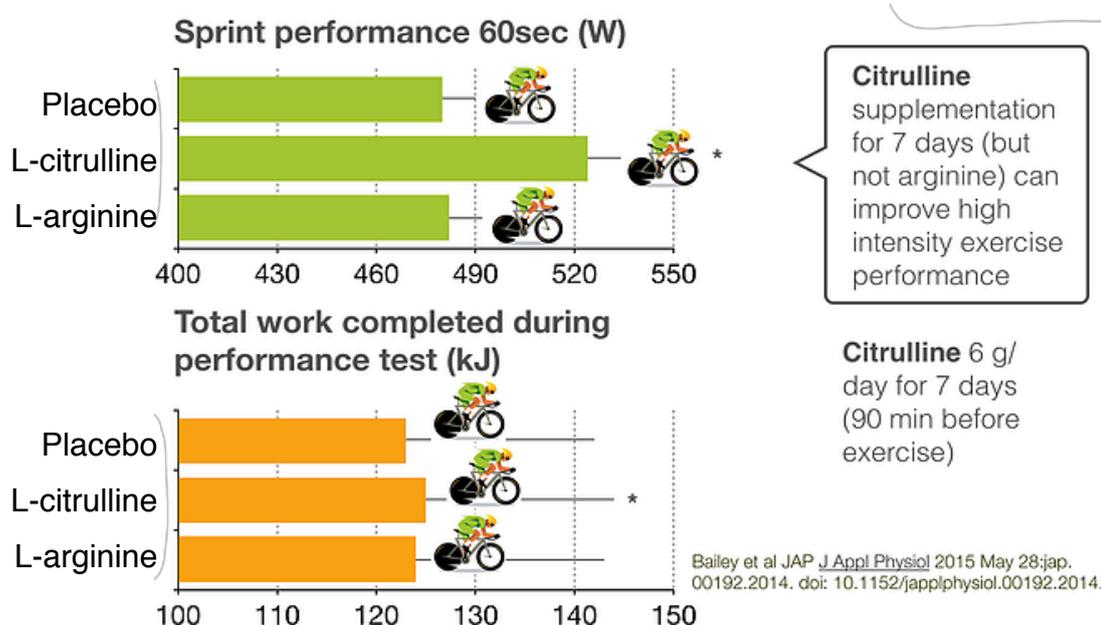


# L-citrulline, L-arginine and high intensity exercise performance

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## Effects of L-citrulline and L-arginine on Performance



Nitric oxide (NO) is a very small but very important molecule in the human body. It plays a crucial role in many processes in the body. For example it is known that nitric oxide plays a role in the regulation of blood flow and blood pressure amongst many other functions.

Nitric oxide is made in the body from nitrites and nitrites can be made out of nitrate (from beetroot juice for example). Nitric oxide is also made from the amino acid L-arginine. It is often suggested that L-arginine supplementation can help NO production. The problem is that most of the L-arginine is broken down or converted before it reaches tissues. It is estimated that only 1% of ingested L-arginine is available. Another way to increase L-arginine in the body could be to ingest L-citrulline. This is not broken down but is converted in the body to L-arginine.

Studies with beetroot juice (a dietary source of nitrate) have suggested beneficial effects for athletes. Studies have shown that dietary nitrate supplementation can increase NO biomarkers (suggesting NO has indeed increased), reduce blood pressure and improve exercise economy/efficiency and exercise tolerance in healthy adults. There is however, a continuing search for other ingredients that can stimulate NO synthesis.

### New study

A recent study at the University of Exeter led by Dr Stephen Bailey investigated the possible role of L-citrulline and L-arginine. Ten healthy adult males completed moderate- and severe-intensity cycling exercise on days 6 and 7 of a 7 day supplementation period with placebo, L-arginine or L-citrulline.

The order of the trials was randomised, the study included a placebo and all subjects performed all trials (cross-over study). Blood pressure was measured as well as blood L-arginine and nitrite concentrations. The performance test was a test that consisted of 10 min all-out exercise with a

sprint in the last 60 seconds. Performance was measured as the total amount of work performed in the test as well as the ability to sprint at the end.

The first notable finding was that both L-arginine and L-citrulline resulted in elevated L-arginine concentrations in the blood. Blood pressure was only lower with L-citrulline supplementation but not with L-arginine. L-citrulline also improved tolerance to severe-intensity exercise and increased the total amount of work completed in the exercise performance test. L-arginine supplementation had no effects on blood pressure or performance.

The authors concluded that these results suggest that 7 days of L-citrulline (6g/day), but not L-arginine supplementation can improve blood pressure and exercise performance in healthy adults.

## Summary of findings

The important new findings from this study are that short-term supplementation with L-citrulline:

- increased the nitric oxide synthase substrate L-arginine
- tended to increase plasma nitrite concentration, a marker of nitric oxide production
- improved high intensity exercise performance
- improved muscle oxygenation
- resulted in faster oxygen uptake kinetics

## Reference

L-citrulline supplementation improves O<sub>2</sub> uptake kinetics and high-intensity exercise performance in humans.

SJ. Bailey, JR Blackwell, T Lord, A Vanhatalo, PG Winyard and AM Jones L-citrulline supplementation improves O<sub>2</sub> uptake kinetics and high-intensity exercise performance in humans. 2015 May 28:jap. 00192.2014. doi: 10.1152/jappphysiol.00192.2014.

# Oral L-citrulline supplementation enhances cycling time trial performance in healthy trained men: Double-blind randomized placebo-controlled 2-way crossover study

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## Abstract

### Background

Many human studies report that nitric oxide (NO) improves sport performance. This is because NO is a potential modulator of blood flow, muscle energy metabolism, and mitochondrial respiration during exercise. L-Citrulline is an amino acid present in the body and is a potent endogenous precursor of L-arginine, which is a substrate for NO synthase. Here, we investigated the effect of oral L-citrulline supplementation on cycling time trial performance in humans.

### Methods

A double-blind randomized placebo-controlled 2-way crossover study was employed. Twenty-two trained males consumed 2.4 g/day of L-citrulline or placebo orally for 7 days. On Day 8 they took 2.4 g of L-citrulline or placebo 1 h before a 4-km cycling time trial. Time taken to complete the 4 km cycle, along with power output/ $VO_2$  ratio ( $PO/VO_2$ ), plasma nitrite and nitrate ( $NO_x$ ) and amino acid levels, and visual analog scale (VAS) scores, was evaluated.

### Results

L-Citrulline supplementation significantly increased plasma L-arginine levels and reduced completion time by 1.5 % ( $p < 0.05$ ) compared with placebo. Moreover, L-citrulline significantly improved subjective feelings of muscle fatigue and concentration immediately after exercise.

### Conclusions

We conclude that oral L-citrulline supplementation enhances cycling time trial performance. Moreover, L-citrulline improves subjective feelings (e.g. of muscle soreness) after performance. These data, taken together, suggest that L-citrulline is a promising amino acid for enhancing sport performance.

### Trial registration

Current Controlled Trials [UMIN000014278](https://www.clinicaltrials.gov/ct2/show/study/UMIN000014278).

Entire Article: US National Library of Medicine , National Institutes of Health  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4759860/>