Can acute ingestion of Citrulline Malate alter substrate utilisation during a cardiorespiratory exercise test with healthy participants?

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Introduction

- Ingestion of Citrulline Malate (CM) has been shown to improve exercise with beneficial effects reported during strength-based assessments and time trial performance[1].
- CM has been reported to increase plasma arginine availability (see figure 1) and subsequent nitric oxide (NO) production, leading to increased blood flow.
- Citrulline, in particular, accelerates the ureagenesis cycle resulting in the removal of ammonium, while Malate is essential for oxidative metabolism which regulates skeletal muscle functions including glucose and fatty acid oxidation.
- Despite this, the metabolic influence of CM has received little attention in the literature. Much of the current literature has primarily focused on performance outcomes during high intensity exhaustive exercise.
- The purpose of this study was to investigate the effects of CM on substrate utilisation during a low-to-moderate cardiorespiratory exercise test.

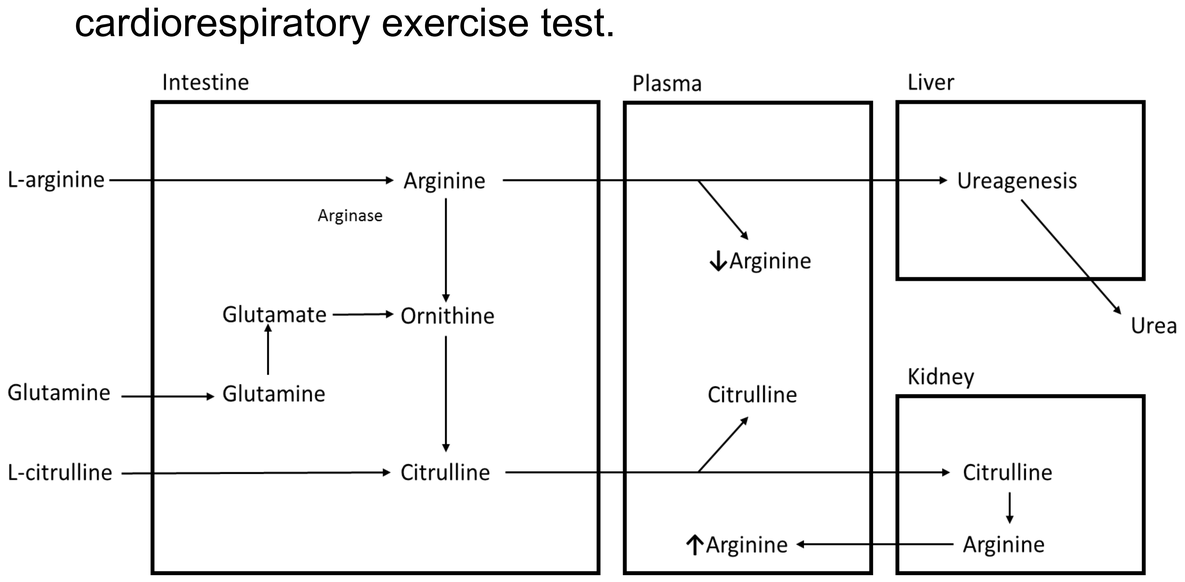
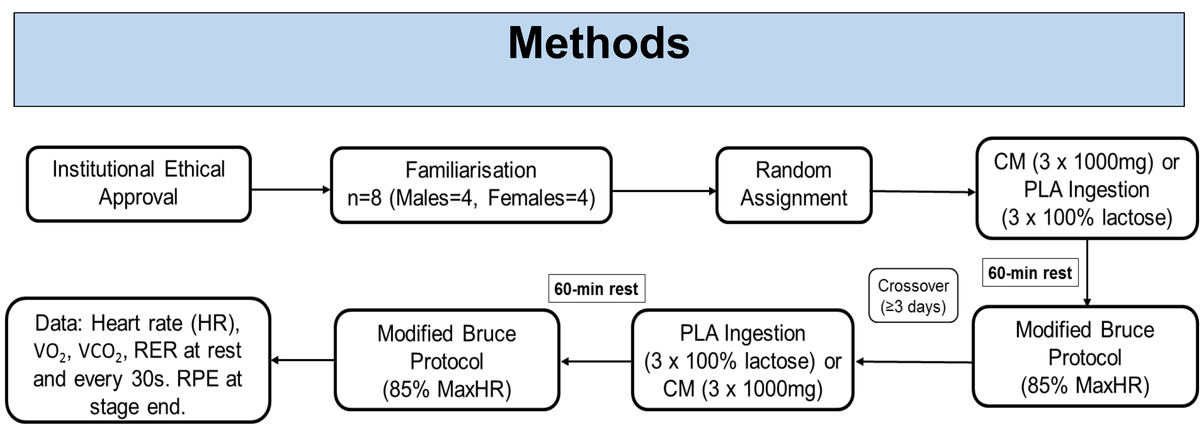


***Figure* 1. The inter-organ pathway taken by L-arginine, Glutamine and L-citrulline.**

Methods



- Respiratory data was subsequently entered into stoichiometric equations to calculate fatty acid oxidation (FAO; $g \cdot min^{-1}$) and carbohydrate oxidation (CHO; $g \cdot min^{-1}$), equations 1 and 2 respectively[2].

$$(1)\ FAO = 1.695 \times VO_2 - 1.701 \times VCO_2$$

$$(2)\ CHO = 4.585 \times VCO_2 - 3.226 \times VO_2$$

- Data Analysis: A paired samples t-test was conducted to compare the time to complete the exercise test following either CM or PLA consumption.
- A factorial repeated-measures analysis of variance (ANOVA) was designed with two levels of condition (CM & PLA) and multiple levels of time (2x7 VO_2, VCO_2, RER, FAO, CHO, HR & RPE at rest and during exercise). Bonferroni post-hoc tests were deployed and effect sizes (Cohen's *d*) calculated.

Results

- There was no significant difference reported for the time (min) to complete the exercise test (P>0.05). No statistical difference was found between conditions for FAO and CHO ($g \cdot min^{-1}$) at any time point (see figure 2).
- All other data showed no significant difference (all P>0.05) in the pre-exercise rest period or at any stage during the exercise test. Main effects similarly showed no significant difference (P>0.05).

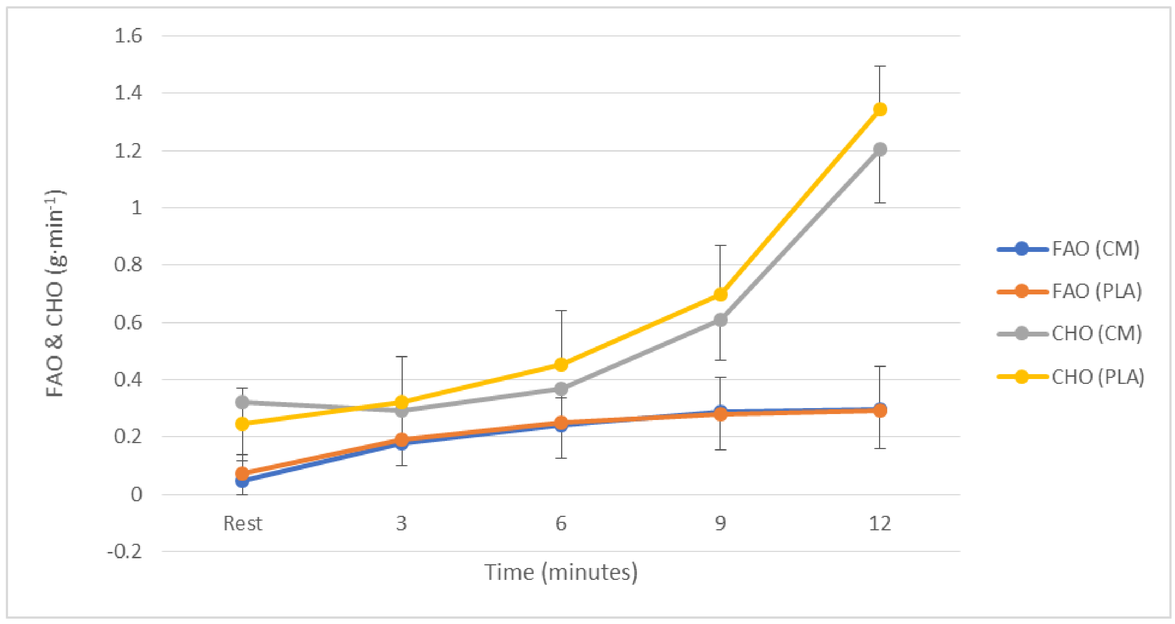


***Figure* 2. Fatty acid (FAO) and carbohydrate oxidation (CHO) during submaximal exercise following ingestion of CM or PLA.**

Summary and Conclusion

- Under strict, controlled laboratory conditions and the use of randomisation in design, this novel control trial compared the effects of a low-dose of CM to a PLA under low-to-moderate intensity exercise.
- Interestingly, this experiment found little to support the hypothesis of CM influencing metabolism under these conditions with healthy participants.
- These findings add to a growing research area on CM supplementation and adaptions to this type of trial are possible (dosage/exercise test/sample) for further study.

Acknowledgements

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References

1. Suzuki, T., Morita, M., Kobayashi, Y., & Kamimura, A. (2016). Oral L-citrulline supplementation enhances cycling time trial performance in healthy trained men: Double-blind randomised placebo-controlled 2-way crossover study. *Journal of The International Society of Sports Nutrition, 13*, 6.

2. Alkhatib, A., Seijo, M., Larumbe, E., & Naclerio, F. (2015). Acute effectiveness of a "fat-loss" product on substrate utilisation, perception of hunger, mood state and rate of perceived exertion at rest and during exercise. *Journal of The International Society of Sports Nutrition, 12*(1), 1-8.