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Infographic. A systematic review and meta-analysis of the effect of β -alanine supplementation on exercise capacity and performance.

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Infographic: A systematic review and meta-analysis of the effect of β -alanine supplementation on exercise capacity and performance

Review Article

Running head: β -alanine for exercise: meta-analysis

Bryan Saunders¹, Adam Virgile², Kirsty Elliott-Sale³, Guilherme G. Artioli¹, Paul A. Swinton⁴, Eimear Dolan¹, Hamilton Roschel¹, Craig Sale³, Bruno Gualano¹

¹Applied Physiology and Nutrition Research Group, University of São Paulo, Brazil.

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³Musculoskeletal Physiology Research Group, Sport, Health and Performance Enhancement Research Centre, Nottingham Trent University, UK.

⁴School of Health Sciences, Robert Gordon University, Aberdeen, UK.

Corresponding author:

Bruno Gualano

Av. Mello de Moraes 65

Butanta, 05508-030

Sao Paulo, SP, Brazil.

Phone: +55 11 2648-1337

Fax: +55 11 3813-5921

E-mail: gualano@usp.br

Carnosine (β -alanyl-L-histidine) is an abundant compound in skeletal muscle suggesting it plays an important role during exercise, with a key physiological role considered to be intracellular pH regulation (Dolan et al., 2019). Chronic β -alanine supplementation can increase muscle carnosine content when taken for several weeks (Harris et al., 2006) and studies have shown that supplementation for between 4 and 24 weeks can improve high-intensity exercise capacity, with the gains in exercise associated with the increase in muscle carnosine content (Hill et al., 2007, Saunders et al., 2017b). Although several studies have demonstrated the efficacy of β -alanine supplementation as an ergogenic aid, there are a number of confounding factors which may modify its effect including exercise type, duration and mode, training status and co-supplementation that may influence the effects of β -alanine supplementation. The aim of our systematic review and meta-analysis was to determine the effects of β -alanine supplementation accounting for these potential modifying factors (Saunders et al., 2017a).

There was a significant overall ergogenic effect of β -alanine supplementation on exercise measures. Exercise duration was the greatest factor influencing the effect size of β -alanine; exercise 0.5 to 10 min in duration results in the greatest effect while very short duration exercise (<0.5 min) clearly resulted in no benefits. Longer duration exercise (>10 min) was not significantly improved with β -alanine, although there was still a moderate sized effect. Exercise capacity and performance protocols were both improved by supplementation, although effect sizes were larger for capacity tests, particularly during exercise lasting from 0.5 to 10 min in duration. The effect of β -alanine on trained individuals showed smaller effect sizes than on non-trained individuals, although these gains may translate into worthwhile improvements in applied settings (*i.e.*, competition). Isolated limb and whole-body exercise benefitted equally from β -alanine supplementation whereas co-supplementation of β -alanine with sodium

bicarbonate, thereby increasing both intracellular and extracellular buffering capacity, was shown to result in greater improvements above β -alanine alone.

These meta-analytical data allow coaches and athletes to make informed decisions as to the likelihood of an ergogenic effect with β -alanine supplementation based upon their specific exercise demands, those performing high-intensity tasks between 30 s and 10 min most likely to benefit. Individuals can safely supplement daily with β -alanine for up to 24 weeks at a dose of $3.2 - 6.4 \text{ g}\cdot\text{day}^{-1}$ ingested at several timepoints throughout the day ($0.8 - 1.6 \text{ g}$ every 3 – 4 h) to avoid acute side-effects (*i.e.*, paraesthesia).

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β -alanine Supplementation To Improve Exercise Capacity And Performance: A Systematic Review And Meta-analysis




Study Details

- ◆ Meta-analysis including 40 studies
- ◆ 1,461 total participants
- ◆ Chronic (>1 day) β -alanine supplementation protocols only

Main Findings

-  **1** β -alanine supplementation increases carnosine in muscle, **delaying fatigue & increasing performance**
-  **2** For performance benefits and avoidance of acute side effects, **daily supplementation** with β -alanine for a **minimum of 2-4 weeks** at a dose of **3.2-6.4 grams/day**, ingested at several time points throughout the day (**0.8-1.6 grams every 3-4 hours**), is advised

How It Works

-  **1** Intense exercise causes **hydrogen (H⁺) ions to accumulate in muscle**, creating an acidic environment
-  **2** H⁺ buildup (muscle acidity) causes **muscle fatigue and decreased performance**. This is the burning sensation you may feel at the end of a difficult exercise session
-  **3** Carnosine buffers the H⁺ ions, helping the muscles maintain a stable environment. This **delays muscle fatigue and can increase performance**

Exercise Types

Intermittent or continuous exercise lasting 30s to 10min (there appears to be no benefit for activities lasting <30 seconds)

How Much

3.2-6.4 g/day;
0.6-1.6g every 3-4 hours during the day

How Long

2-4 weeks appears to be an ideal period of time for supplementation



Created by Adam Virgile
adamvirgile.com

Social Media @AdamVirgile @AVSportSci



Graphic References

Saunders, B., Elliott-Sale, K., Arioli, G.G., Swinton, P.A., Dolan, E., Roschel, H., Sale, C. and Gustano, B., 2017. β -alanine supplementation to improve exercise capacity and performance: a systematic review and meta-analysis. *British Journal of Sports Medicine*, 51(8), pp.658-669.



The dose information is perhaps a little repetitive; it is included on the left under Main findings, and on the right (How much, How long). I am also unsure about the “Main Findings” as this wasn’t the aim of the meta-analysis; we didn’t measure muscle carnosine or the optimal dose. The only thing we really measured in this study was exercise outcomes. I thought maybe we put the main exercise outcomes as the Main Findings, and then the current points 1 and 2 (as they are) as the recommendations on the right of the infographic? Something like that?

Perhaps:

Main Findings

β -alanine supplementation improves exercise capacity and performance, intermittent and continuous, whole-body and isolated limb.

Greatest effect of β -alanine on exercise lasting 0.5 – 10 min. No benefit for activities <30 s while moderate effect on exercise >10 min was not significant.

The effect of β -alanine on trained individuals showed smaller effect sizes than on non-trained individuals, but this may translate into worthwhile improvements for competition.

β-alanine Supplementation to Improve Exercise Capacity and Performance: A Systematic Review and Meta-analysis

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Effects of β-alanine by Exercise Duration

Short (≤ 0.5 mins)

0.05 [-0.14, 0.23]

Moderate (0.5-10 mins)

0.22 [0.09, 0.36]

Long (> 10 mins)

0.19 [-0.07, 0.45]

Overall

0.18 [0.08, 0.28]

Effect Size [95% CI]

Diamond length represents 95% CI

-1 0 1

Favors Placebo

Favors β-alanine

How It Works

1

Intense exercise causes hydrogen (H⁺) ions to accumulate in muscle, creating an acidic environment.

2

H⁺ buildup (muscle acidity) negatively impacts muscle function, and causes muscle fatigue and decreased performance.

3

Carnosine buffers the H⁺ ions, helping the muscles maintain a stable environment. This delays muscle fatigue and can increase performance.

General Recommendations

Exercise Types

Intermittent or continuous exercise lasting 30s-10min in duration, such as 100-200m swimming, 4km cycling, 2000m rowing & 800m running

How Much

3.2-6.4 grams/day; 0.6-1.6 grams every 3-4hrs during the day to avoid acute side effects of paraesthesia

How Long

2-4 weeks of supplementation at the recommended dose

Key Takeaways

1

β-alanine increases muscle carnosine, leading to improvements in exercise capacity & performance during continuous & intermittent activities

2

Effects are greatest for exercise lasting 30s-10min, with smaller effects seen in trained versus untrained individuals

3

Acute co-supplementation of sodium bicarbonate may further improve exercise gains