BOOK OF ABSTRACTS **Open Access**

Relationship between skeletal muscle carnosine content and cycling sprint performance

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Purpose:

High-intensity exercise is limited by muscle acidosis, among other factors. Supplementation with buffering agents can delay the onset of muscular fatigue and improve performance (Saunders et al., 2017, Heibel et al., 2018). These include supplements that can increase the extracellular buffering capacity (e.g., sodium bicarbonate, which increases blood bicarbonate) and the intracellular buffering capacity (e.g., beta-alanine, which increases muscle carnosine). Since high-intensity performance has been associated with hydrogen ion buffering capacity (Rampinini et al., 2009), we sought to examine whether pre-exercise blood bicarbonate concentration and muscle carnosine content are associated with repeated-sprint cycling performance.
To determine the relationship between blood bicarbonate and muscle carnosine of trained cyclists and high-intensity performance during the 4-bout Wingate cycling test.

Methods:

Forty-one trained male cyclists (age: 35 ± 7 y; weight: 74.7 ± 10.5 kg; height: 1.78 ± 0.08 m) that had been training for at least 2 years (experience: 9 ± 8 years; training hours: 12 ± 6 hours·week^{-1}; training distance: 261 ± 165 km·week^{-1}) participated in the study. Participants were required not to have used supplements containing creatine in the 3 months, or beta-alanine in the 6 months prior to the study. A 4-bout Wingate cycling test (30 s all-out with 3-min passive recovery between bouts) protocol was performed on a mechanically braked cycle-ergometer. Total mechanical work (TMW) was determined for each single bout and for the overall protocol (i.e., the four bouts altogether). Blood samples were taken immediately before and after exercise for the determination of blood pH and bicarbonate using a blood gas analyser (Rapid Point 350, Siemens, Germany). Sample muscles were obtained from the *m. vastus lateralis* using the biopsy technique; carnosine was determined using tandem liquid chromatography-mass spectrometry (HPLC-ESI^{+}-MS/MS) as des cribed by Carvalho et al. (2018). Data are presented as mean ± 1 standard deviation. The relationship between blood bicarbonate and muscle carnosine variables and exercise performance was determined using Pearson's correlation and a paired t-test was used to compare blood variables before and after the exercise test. All data were analysed using GraphPad 6.0 and statistical significance was accepted at $p < 0.05$. Blood samples could not be obtained or analysed in 19 participants. Likewise, complete data of the entire 4-bout protocol could not be obtained in 15 participants; therefore 22 were included in the analysis involving blood variables and overall TMW and 26 individuals involving blood variables and individual bouts.

Results:

No significant correlation was shown between overall TMW and pre-exercise resting bicarbonate concentration (R = 0.01; p = 0.97) or muscle carnosine (R = 0.276; p = 0.08; Figure 1). Similarly, no significant correlation was shown between TMW in the four individual bouts and pre-exercise resting bicarbonate concentration or muscle carnosine (all

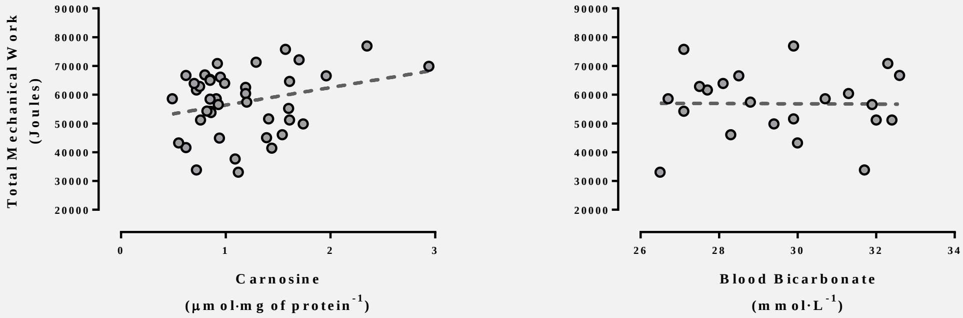

Figure 1. Correlation between muscle carnosine and blood bicarbonate with overall total mechanical work

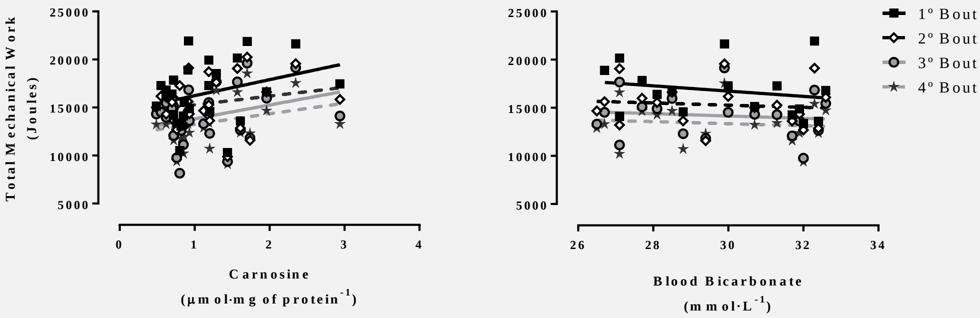

Figure 2. Correlation between muscle carnosine and blood bicarbonate with total mechanical work through four bouts

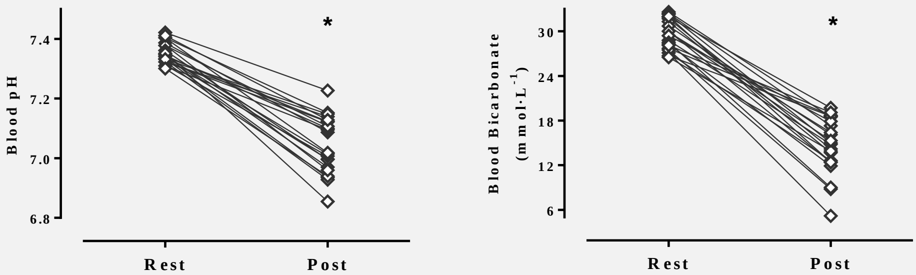

Figure 3. Blood pH and bicarbonate analyses at the rest and post exercise. *significate difference compare to rest (p < 0.001).

p > 0.05; Figure 2). A significant decrease in blood bicarbonate (rest 29.6 ± 2.1 *vs* post 14.6 ± 3.7 mmol·L^{-1}; *p* < 0.0001) and blood pH (rest 7.353 ± 0.035 *vs* post 7.048 ± 0.094; *p* < 0.0001; Figure 3) was shown following the cycling protocol.

Conclusion:

This study showed no association between repeated sprint cycling performance and blood bicarbonate or muscle carnosine, suggesting that neither initial blood bicarbonate concentration nor muscle carnosine content influences performance during this type of exercise. Interestingly, sodium bicarbonate and beta-alanine supplementation have previously been shown to improve repeated Wingate performance, particularly in the final bouts (Tobias et al., 2013, Artioli et al., 2007, Painelli et al., 2014). Since fatigue during high-intensity activity is multifactorial, this may indicate that small baseline variations in blood bicarbonate and muscle carnosine are not large enough to translate into performance benefits. It is likely that supplementation with sodium bicarbonate and beta-alanine, on the other hand, result in changes of sufficient magnitude to delay fatigue and improve performance.

The current study showed that initial levels of blood bicarbonate and muscle carnosine were not associated with repeated Wingate performance, suggesting that these variables are not good predictors of cycling sprint performance.

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