

The physiological stress response to anaerobic exercise is altered following sodium bicarbonate supplementation

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Introduction

Sodium bicarbonate (NaHCO₃) is a nutritional aid that is proposed to enhance performance by reducing the state of exercise induced acidosis, however research is currently equivocal. Despite this, most research still focuses on its effects upon performance, and not whether the reduced acidosis impacts upon any other factors related to exercise. There is some research to suggest that such a reduction in [H⁺] can attenuate a number of physiological stress pathways such as stress hormones (1, 4), heat shock protein 72 (HSP72) and oxidative stress (3), suggesting a potential role in exercise recovery. However there are some limitations with this previous research as work intensities were not controlled for, hence making comparisons between treatments difficult. Also limited markers of stress were measured despite the physiological stress response being multi-faceted. The aim of this study was to examine whether the ingestion of NaHCO₃ would influence the expression of several markers of stress measured simultaneously, following a work controlled anaerobic exercise.

Methods

Seven active males volunteered for the study (age 22 ± 3 years, height 1.82 ± 0.06 m, mass 81.3 ± 8.4 kg, peak power output 300 ± 22 W), reporting to the lab on 3 occasions. Visit 1 was a peak power output (PPO) test and familiarisation, and sessions 2 and 3 were the exercise trials performed under placebo (PLAC; capsules containing 0.045g.kg.BW⁻¹ NaCl) or experimental (BICARB; capsules containing 0.03g.kg.BW⁻¹ NaHCO₃) conditions in a randomised manner. The exercise trials consisted of 10x15-sec cycle sprints at 120% PPO separated by 45-sec of active recovery. Stress was measured via monocyte expressed HSP72, plasma thiobarbituric acid reactive substances (TBARS), serum cortisol, serum interleukin 6 (IL-6) and serum interleukin 8 (IL-8) at rest and immediately, 90-min and 180-min post-exercise. All statistical analyses were completed using IBM SPSS Statistics 18 (SPSS Inc., Chicago, IL). The change in stress markers across condition and time were analysed using linear mixed models. Two-tailed statistical significance was accepted as p < 0.05.

Results

The ingestion of NaHCO₃ significantly elevated blood pH, HCO₃ and base excess, and significantly lowered H⁺ (p<0.05). In addition all acid-base variables remained closer to homeostatic values immediately and 10-min post-exercise in BICARB (p<0.05), apart from blood lactate where there were no significant differences between conditions. The expression of HSP72 was significantly increased at all time points post-exercise in PLAC compared to rest (p≤0.027), and compared to BICARB (p≤0.021) (Fig 1). Plasma TBARS remained close to resting values after exercise in BICARB, dropping by on average 30% 90-min post. In

contrast plasma TBARS peaked by on average 30% immediately post PLAC, staying elevated throughout the testing period (Fig 2). As such there was a main effect between conditions evident ($p=0.039$). Cortisol increased marginally immediately post-exercise in both trials before gradually lowering below baseline, resulting in a significant main effect for time ($p < 0.001$). There was no significant difference between conditions ($p=0.107$). In addition cortisol concentration was significantly higher in BICARB compared to PLAC 180-min post-exercise ($p=0.034$). IL-6 was not significantly induced at any time point in either trial, and IL-8 was undetectable.

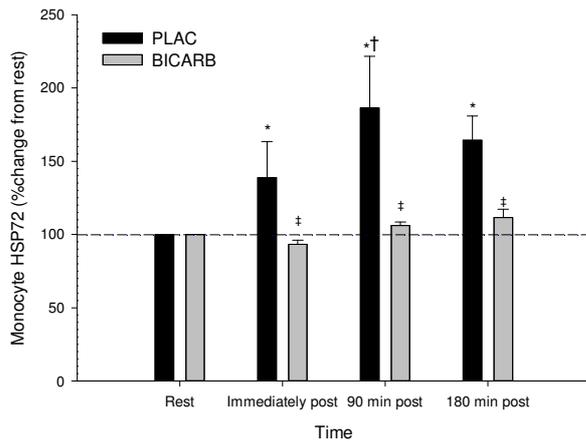


Figure 1. Monocyte expressed HSP72 throughout the testing period. * significantly different to rest, † significantly different to immediately post, ‡ significantly different to PLAC

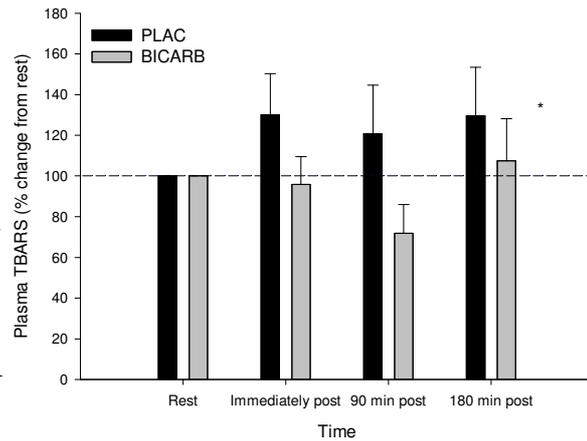


Figure 2. Plasma TBARS throughout the testing period. * significant main effect between conditions.

Discussion and Conclusion

This data demonstrates that the ingestion of NaHCO_3 has the potential to attenuate the HSP72 and oxidative stress response to a work controlled anaerobic exercise, supporting previous work from our lab (3). Future work should now investigate the practicalities of a reduced HSP72 and oxidative stress response in the 180-min post-exercise with NaHCO_3 in terms of potential implications for recovery and/or performance, particularly as it is common for athletes to train twice in this time frame (2). An additional finding of this study is that HSP72 and TBARS are a more sensitive marker of acute stress following anaerobic exercise than IL-6, IL-8 and cortisol.

References

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