Effect of inorganic nitrate supplementation on O_2 uptake kinetics and exercise tolerance: influence of muscle oxygenation

Abstract

We tested the hypothesis that inorganic nitrate (NO_3^-) supplementation would improve muscle oxygenation, oxygen uptake ($\dot{V}O_2$) kinetics and exercise tolerance (T_{lim}) in normoxia and that these improvements would be augmented in hypoxia and attenuated in hyperoxia. In a randomized, cross-over study, ten healthy males completed work-to-work step cycle tests to exhaustion following acute consumption of 210 mL NO_3^--rich beetroot juice (BR; 18.6 mmol NO_3^-) and NO_3^--depleted beetroot juice placebo (PL; 0.12 mmol NO_3^-). These tests were completed in normobaric normoxia (FIO2: 21%), hypoxia (FIO2: 15%) and hyperoxia (FIO2: 40%). Pulmonary $\dot{V}O_2$ and quadriceps tissue oxygenation index (TOI), derived from mutli-channel near-infrared spectroscopy, were measured during all trials. Plasma [nitrite] was higher in all BR compared to all PL trials (P<0.05). Quadriceps TOI was higher in normoxia compared to hypoxia (P<0.05) and higher in the hyperoxia compared to hypoxia and normoxia (P<0.05). T_{lim} was improved after BR compared to PL ingestion (250 ± 44 vs. 231 ± 41 s), with the magnitude of improvement being negatively correlated with quadriceps TOI at exhaustion (r = -0.78), in the hypoxic trials (P<0.05). T_{lim} tended to be improved with BR in normoxia (BR: 364 ± 98 vs. PL: 344 ± 78 s; P=0.087), but was not improved in hyperoxia (BR: 492 ± 212 vs. PL: 472 ± 196 s; P>0.05). BR ingestion increased peak $\dot{V}O_2$ in hypoxia (P<0.05), but not normoxia or hyperoxia (P>0.05). Therefore, NO_3^- supplementation is more likely to improve T_{lim} and peak $\dot{V}O_2$ as skeletal muscles become increasingly hypoxic.

Key Words: nitric oxide; vascular function; oxidative metabolism; exercise performance; fatigue; near-infrared spectroscopy