EFFECTS OF ACUTE NITROGEN SUPPLEMENTATION ON HIGH INTENSITY INTERMITTENT EXERCISE

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INTRODUCTION: Athletes and coaches are continually trying to find ways to improve sport performance. Supplementation with dietary nitrate as a means to improve sport performance has gained a lot of attention recently. Nitric oxide (NOS) gained through the NOS independent pathway from dietary nitrate has been shown to provide vascular benefits. Previous studies have indicated NOS modulates blood pressure, blood flow, ATP cost efficiency, glucose uptake, muscular contraction, platelet aggregation, cellular oxygen utilization, and oxidative phosphorylation efficiency (Larsen et al., 2007; Lidder et al., 2013; Machha et al., 2011; Webb et al., 2008; Wylie et al., 2013). Nitric oxide is also important in adaptation to physical exercise and control of cellular respiration. Inorganic nitrate supplementation has been shown to extend time to exhaustion among endurance athletes, increase exercise capacity, and reduce the cost of oxygen consumption (Bailey et al., 2009; Kelly et al., 2013; Lansley et al., 2011; Larsen et al., 2010; Larsen et al., 2007). Mechanisms that explain the ergogenic effects of nitrate supplementation are not fully understood. One mechanism theorized to improve the cost of oxygen consumption is mitochondrial efficiency, due to the reduced proton leakage within the electron transport chain. Increased muscle contractile efficiency has also been observed after nitrate supplementation (Bailey et al., 2009; Kelly et al., 2013; Lidder et al., 2013). The research on nitrate supplementation has been equivocal and further research is required to examine the potential benefits. The main objective of this study was to determine if the research on nitrate supplementation supports a potential benefit to intermittent activity sports such as soccer. Because the Yo-Yo IR test (YYIR1) has been correlated with soccer match performance and previous studies have indicated an improvement on the YYIR1 test after nitration supplementation, it was hypothesized that beetroot juice supplementation may be a useful ergogenic aid to improve performance in soccer players.

METHODS: Research on nitrate supplementation was gathered using the following databases: Ebsco, Taylor & Francis and Google Scholar. The main objective was to identify studies that investigated the effect of nitrate supplementation on sport performance. The following keywords were used in the search for articles: Beetroot juice, athletic performance, soccer, Yo-Yo IR1 test, running, rowing, cycling. Abstracts and complete articles were reviewed to identify the physiological effects of dietary nitrate on exercise performance, and specifically the effects on soccer related performance. Articles included date from the 2006 to 2014. The research examined included the effect of both acute and chronic supplementation with beetroot juice.

RESULTS: The majority of articles supported the hypothesis that beetroot juice supplementation may enhance athletic performance. Previous research has indicated a correlation between the Yo-Yo IR1 test and soccer match performance and studies on nitration supplementation have shown an improved performance on the YYIR1 after ingestion of beetroot juice.

DISCUSSION: The research indicated that supplementation with beetroot juice has increased performance on the YYIR1 test and, therefore, nitrate supplementation may confer physiological benefits to soccer

players. However, Lee et al. (2013) found no effect on knee extensor muscle fatigue or on maximum work rate and peak torque among 35 recreationally active participants. Boorsma et al. (2014) found no effect on performance in elite 1500-m runners. In contrast, Lansley et al. (2011) found that beetroot juice improved performance among club level competitive cyclists. Time trial (TT) performance and power output was improved after the participants ingested 0.5L of beetroot juice ~ 2.5 hours before the competition of a 4km and a 16.1km TT. Cermak et al. (2012) found reduced consumption of O2 during a submaximal cycle ergometer test and increased time to exhaustion during constant power output was observed after nitrate supplementation. Overall, 10km cycling TT performance was improved according to the authors. Lansley et al. (2010) observed increased exercise tolerance and reduced oxygen cost during moderate-intensity walking and running among nine healthy, physically active male participants after performing treadmill and knee-extension tests. Bond et al. (2012) found that nitrate supplementation also resulted in improved maximal rowing-ergometer repetitions in well-trained rowers. Bailey et al. (2009) observed enhanced tolerance to high-intensity exercise and reduced oxygen cost during low-intensity and moderate-intensity exercise in eight male participants after completing a series of moderate and severe-intensity step exercise tests. Bescós et al. (2011) found a reduction in peak oxygen consumption without compromising maximal exercise performance among 11 non-elite cyclists after performing a cycle ergometer test.

Because the YYIR1 has been correlated with soccer match performance, studies examining the effect of nitrate supplementation on the YYIR1 test were examined. All studies showed improved performance on the YYIR1 after the ingestion of beetroot juice. Therefore, it can be hypothesized that beetroot juice supplementation may improve performance in soccer players. The most common dosage of dietary nitrate in the form of beetroot juice used in the studies contained 5 to 10 mmol of nitrate (Bailey et. at., 2009; Cermak et al., 2012; Kelly et al., 2013; Lidder et al., 2013; Lansley et al., 2011; Zafeiridis et al., 2014). Effects of dietary nitrate supplementation were observed after short-term (2 to 3 h prior to exercise; Bescós et al., 2011; Cermak et al., 2012; Lansley et al., 2011; Lee et al., 2013; Webb et al., 2008) and after long-term (2 to 15 days; Bailey et. at., 2009; Bond et al., 2012; Cermak et al., 2012; Lee et al., 2013; Larsen et al., 2007; Machha et al. 2011; Wylie et al., 2013) supplementation. For high intensity exercise, the biggest effects are observed after long-term supplementation (6 days). Most studies used 500 ml of beetroot juice supplement (Bailey et. at., 2009; Kelly et al., 2013; Lansley et al., 2011; Lidder et al., 2013). Therefore we estimated that an effective dose would be 500 ml of 5 to 10 mmol of beetroot juice supplement 6 h before exercise.

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