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Editorial

Exercise Performance and Dietary Nitrate Supplementation: A Brief Comment

Gustavo Vieira de Oliveira

Department of Phamacology and Medicine, Federal University of Rio de Janeiro, Macaé, RJ, Brazil

***Correspondence to:** Dr. Gustavo Vieira de Oliveira, Department of Phamacology and Medicine, Federal University of Rio de Janeiro, Macaé, RJ, Brazil.

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The dietary nitrate supplementation effect on exercise performance has been extensively studied. The consumption of vegetable rich in nitrate such as spinach, lettuce, and beetroot has gained popularity in the scientific literature due to the possible effect of the nitrate present in this food to promote nitric oxide (NO) bioconversion. The dietary nitrate can be reduced to nitrite in the oral cavity by the enzymatic action of nitrate reductase, which is expressed by oral commensal bacteria. Once in contact with gastric acid from the stomach, nitrite may be decomposed into NO and other bioactive nitrogen oxides [1]. In addition, NO bioconversion from nitrite may be favored during muscle contraction in exercise due to the intracellular homeostatic perturbation (i.e. low pH and low oxygen pressure) [1].

The NO is important for exercise performance since regulates blood flow to the muscle during exercise, modulates muscular contraction and glucose uptake. Additionally, it is involved in the control of cellular respiration through interaction with enzymes of the mitochondrial respiratory chain [2,3,4]. In the first time, Larsen *et al.* (2007) [5] demonstrated a significant reduction of the oxygen cost in 9 healthy, well-trained males subjects during submaximal exercise after 3 days of nitrate supplementation (0.1mmol kg -1 of sodium nitrate/day). This effect occurred without an accompanying increase in lactate concentration, indicating that the energy production had become more efficient.

After the Larsen *et al.* (2007) [5] study, several others studies have been demonstrated improvements in muscle oxygenation status [6,7], muscle force [8], muscle energy economy during exercise [4,9] and exercise tolerance [10,11] in physically active subjects after a single dose and/or multiday (> 3 days) usage of dietary nitrate supplementation. However, the ergogenic effect of dietary nitrate supplementation on exercise performance of well-trained subjects remains unclear.

Studies that evaluate the effects of the dietary nitrate supplementation in different sport modalities, such as trained cyclists [12-16] runners [17] kayakers [18] and swimmers [19] have failed to demonstrate improvement on exercise performance. In contrast, one study in trained kayakers [20], two in rowers [21,22] and one in jiu-jitsu subjects [23] have shown improvements in exercise performance after dietary nitrate supplementation.

Porcelli *et al.* (2015) [24] reported a significant inverse correlation between aerobic fitness level and improvement in 3-km time trial running performance after 6 days of sodium nitrate supplementation. Hence, a possible explanation for the absence of the effect in exercise performance in well-trained subjects after the dietary nitrate supplementation may be related to the level of physical conditioning induced by each type of exercise. For example, there are distinct pathways that regulate either cell growth and/or mitochondrial biogenesis, resulting in a response that is largely exclusive for one type of exercise or another [25,26].

Interestingly, a recent systematic review and meta-analysis investigated whether different fitness levels (non-athletes versus athletes or classification of performance levels), duration of the test used to measure performance (short versus long duration) and the test protocol (time trials versus open-ended tests versus graded-exercise tests) influence the effects of dietary nitrate supplementation on exercise performance [27]. The authors concluded that dietary nitrate supplementation improves exercise performance in non-athletes, particularly in performance evaluations using long-duration open-ended tests (open-ended tests consist of exercising at a constant power until the participant is volitionally fatigued). Furthermore, dietary nitrate supplementation does not appear to benefit the exercise performance of athletes.

In summary, although several studies have evaluated the dietary nitrate supplementation effect on exercise performance, many questions still need to be answered. For example, resistance training generates different muscle adaptation compared to endurance training [26]. Thus, the effect of dietary nitrate in resistance exercise and/or in concurrent training (resistance training combined with aerobic training in a single program) is unknown. Therefore, future studies should be conducted to answer these doubts.

Conflicts of Interests

The author declare that he has no conflict of interest related to this article.

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