4-9-2016

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Effects of Single-Dose Dietary Nitrate on Oxygen Consumption During and After Maximal Exercise in Healthy Humans

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INTRODUCTION

• Oxygen is the substrate for aerobic metabolism; with exercise, oxygen consumption (VO2) will increase to provide the substrate for energy production. As VO2 increases, energy expenditure (Kcal) also increases.
• As exercise begins, the amount of O2 needed increases faster than the body can increase its uptake. At cessation of exercise, the body continues to maintain an elevated VO2 rate to make up for the deficit. This continued elevated intake is referred to as excess post-exercise oxygen consumption (EPOC).
• Dietary nitrate supplementation has been shown to decrease VO2 at a given workload, increase performance in time trial time, and decrease diastolic blood pressure. However, there is a lack of published data regarding the effect of nitrate supplementation on EPOC.
• Therefore, we tested the hypothesis that acute nitrate supplementation in the form of beetroot juice will significantly decrease VO2 max and excess post-exercise oxygen consumption (EPOC).

METHODS

Subjects, Instrumentation and Measurements
- A total of 8 healthy young individuals aged 19-31
  - maximal, n=4; submaximal, n=4
  - Parvo Medics TrueOne 2400 Metabolic Cart
  - Heart rate (HR) determined by Polar H7 Smart Chest Transmitter
  - Blood pressure (BP) measured with automatic sphygmomanometer
  - RPE measured on a 6-20 Borg Scale

Control Condition
- 70 ml antibacterial mouthwash rinse
- prevent conversion from NO2 to NO
- 70 ml Beet Sport Shot (BR)

Nitrate Supplementation
- 70 ml water rinse
- 70 ml Beet Sport Shot (BR)
- administered orally

Cycle Ergometry
- 5 experimental visits
- Maximal Exercise (Control)
- Maximal Exercise (BR)
  - Prolonged (45 min) Submaximal (% of Ctrl Max) (Control)
  - Prolonged (45 min) Submaximal (% of Ctrl Max) (BR)
  - Prolonged (45 min) Submaximal (% of BR Max) (BR)

Experimental Protocol

RESULTS

1 Subject Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>24.88 ± 1.41</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>181.29 ± 2.88</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>78.15 ± 3.17</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>15.81 ± 1.50</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.71 ± 0.40</td>
</tr>
</tbody>
</table>

2 Pre-Exercise Energy Expenditure

<table>
<thead>
<tr>
<th>Condition</th>
<th>Energy Expenditure (Kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>Nitrate</td>
<td></td>
</tr>
</tbody>
</table>

3 VO2 Max

<table>
<thead>
<tr>
<th>Condition</th>
<th>VO2 Max (ml/kg/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>34.2 ± 3.9 L</td>
</tr>
<tr>
<td>Nitrate</td>
<td>31.7 ± 4.4 L</td>
</tr>
</tbody>
</table>

4 Dynamic Oxygen Consumption

5 Post-Exercise Energy Expenditure

<table>
<thead>
<tr>
<th>Condition</th>
<th>Energy Expenditure (Kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>Nitrate</td>
<td></td>
</tr>
</tbody>
</table>

6 60 Minute EPOC

<table>
<thead>
<tr>
<th>Condition</th>
<th>EPOC (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.3 ± 0.41 L</td>
</tr>
<tr>
<td>Nitrate</td>
<td>0.0 ± 0.31 L</td>
</tr>
</tbody>
</table>

CONCLUSIONS

• Contrary to our hypothesis, in young, healthy, untrained males, VO2 max is not attenuated with nitrate supplementation.
• Accordingly, contrary to our hypothesis, EPOC is not lower in this condition.
• These findings are relevant given the increase in supplementation use, particularly for both health and performance goals.
• Some experimental considerations include:
  - Subject population and number
  - Electronically-braked ergometer not used
  - No familiarization visits
  - Lack of plasma NO2 measures

PERSPECTIVES

The collective data derived from the present investigation fails to provide evidence to support our hypothesis that nitrate supplementation will significantly decrease maximal oxygen consumption and EPOC. Follow-up investigations should test highly-trained males in order to observe the effects of NO2 supplementation on VO2 max in this population. If no significant effects are seen in the elite population, this could impact the growing use of the supplement as an ergogenic aid in sport performance.

REFERENCES


ACKNOWLEDGEMENTS

We thank the subjects who volunteered for this study.
This research was supported by the University of Dayton Honors Program, the Berry Summer Thesis Institute Fellowship, the University of Dayton Office for Research, and the Department of Health and Sport Science.