Effects of Differing Post-Exercise Drinks on EPOC, Substrate Utilization, and Energy Expenditure

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Sarah Evans
Kaitlin Hiserote
Introduction: Why is this study important?

- Recent upsurge of interest in how sports drinks affect energy expenditure and substrate utilization after exercise is completed

- Two key reasons:
  - Weight Control
  - Recovery
Introduction: What is EPOC?

- Excess Post–Exercise Oxygen Consumption
- Possible Explanations:
  - Replenish ATP and PCr
  - Replenish O\textsubscript{2} stores in hemoglobin + myoglobin
  - Clear lactate and carbon dioxide
Introduction: What is substrate utilization?

- Respiratory Exchange Ratio (RER)
  - Ratio of carbon dioxide produced to oxygen consumed (VCO₂/VO₂)
  - RER increases during increased carbohydrate oxidation
  - RER decreases during increased fat oxidation
Introduction: How is this study different from previous studies?

- Most studies on EPOC and substrate utilization examine post-exercise meal consumption, not sports drink consumption
- Most studies on sports drinks – performance, fluid retention, endurance
- Few previous studies on the metabolic effects of combined carbohydrate and protein ingestion
Variables

- Independent Variables:
  - Sports Drink Type
  - Time

- Dependent Variables:
  - Post-exercise oxygen consumption (VO\textsubscript{2})
  - Post-exercise substrate utilization (RER)
  - Post-exercise energy expenditure (Kcal/min)
Hypotheses

- There will be no difference between the energy drink types for any of the dependent variables (VO$_2$, RER, Kcal).

- There will be no difference over time for any of the dependent variables (VO$_2$, RER, Kcal).

- There will be no interaction effects between type of energy drink and time for any of the dependent variables (VO$_2$, RER, Kcal).
Methodology: Population and Preliminary Session

- 8 male subjects between the ages of 18 – 24
- Written informed consent
- Equipment familiarization
- Preliminary data collection
  - Height
  - Weight
  - VO$_2$ max measured via a traditional treadmill protocol at 0% grade with increasing speed
Methodology: Experimental Sessions

- Administered in a subject-blinded, randomized, and counterbalanced order

- 3 experimental sessions for each subject:
  - Control session (CON)
    - Non-caloric Totally Light™
  - Carbohydrate sports drink session (CARB)
    - Gatorade™
  - Carbohydrate–protein sports drink session (CARB–PROT)
    - Accelerade™
Methodology: Data Collection

- Record Entering Weight
- After resting for 10 minutes in a supine position, collected baseline data for 10 minutes
- Treadmill running for 30 minutes at 70% $VO_2$ max
  - $VO_2$ max data used to calculate treadmill speed to achieve and maintain 70% $VO_2$ max
  - Heart rate data collected throughout exercise to verify exercise intensity
Methodology: Data Collection

- Consumption of drink within 10 minutes of exercise completion
- 90 minutes of post-exercise data collection in supine position
  - Data collected for 10 minute increments at 30, 60, and 90 minutes post-exercise
Methodology: Statistical Analysis

Data Analysis

- 3 (type) x 3 (time) ANCOVA for each of the dependent variables:
  - EPOC \((VO_2)\)
  - Substrate Utilization (RER)
  - Energy expenditure (Kcal/min)

- Baseline values used as a covariate to reduce error introduced via daily variations in metabolism
# Results: P-Values from Statistical Analysis of Dependent Variables

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Energy Drink Type</th>
<th>Time</th>
<th>Interaction Effects: Type * Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>VO$_2$</td>
<td>0.460</td>
<td>0.576</td>
<td>0.926</td>
</tr>
<tr>
<td>RER</td>
<td>0.370</td>
<td>0.000*</td>
<td>0.597</td>
</tr>
<tr>
<td>Kcals</td>
<td>0.127</td>
<td>0.458</td>
<td>0.900</td>
</tr>
</tbody>
</table>

* P-values less than 0.05 indicate statistical significance
Results: Mean VO₂ Values (ml/kg/min) for each Energy Drink Type and Time

<table>
<thead>
<tr>
<th>Time (p = 0.576)</th>
<th>Energy Drink Type (p = 0.460)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>Baseline</td>
<td>3.672</td>
</tr>
<tr>
<td>30 min</td>
<td>4.309</td>
</tr>
<tr>
<td>60 min</td>
<td>3.979</td>
</tr>
<tr>
<td>90 min</td>
<td>4.202</td>
</tr>
</tbody>
</table>

-No significant differences across energy drink type or time-
Results: Mean RER Values for each Energy Drink Type and Time

<table>
<thead>
<tr>
<th>Time* (p = 0.000)</th>
<th>Energy Drink Type (p = 0.370)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>Baseline</td>
<td>0.9218</td>
</tr>
<tr>
<td>30 min</td>
<td>0.8405</td>
</tr>
<tr>
<td>60 min</td>
<td>0.8013</td>
</tr>
<tr>
<td>90 min</td>
<td>0.7750</td>
</tr>
</tbody>
</table>

- No significant differences across energy drink type but there are significant differences across time
RER Values for each Energy Drink Type over Time

Post Hoc testing revealed 30 min RER significantly greater than 90 min RER (Fisher LSD)
Results: Mean Kcal/min Values for each Energy Drink Type and Time

<table>
<thead>
<tr>
<th>Time (p = 0.458)</th>
<th>Energy Drink Type (p = 0.127)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>Control</td>
</tr>
<tr>
<td></td>
<td>1.338</td>
</tr>
<tr>
<td>30 min</td>
<td>1.547</td>
</tr>
<tr>
<td>60 min</td>
<td>1.420</td>
</tr>
<tr>
<td>90 min</td>
<td>1.486</td>
</tr>
</tbody>
</table>

- No significant differences across energy drink type or time
Discussion

- Successfully obtained data from 8 males between ages 18–24

- Substrate Utilization (RER) varied over time for each of the post-exercise drinks
  - RER significantly lower 90 min post-exercise than 30 min post-exercise
  - Lowered RER indicates increased fat metabolism
  - Supported by previous studies (Stiegler, Sparks, & Cunliffe, 2008; Benton & Swan, 2007)

- VO₂ and Kcal/min increased from baseline but were not significantly different at 30, 60, or 90 minutes
Discussion

- EPOC (VO\textsubscript{2}), substrate utilization (RER), and energy expenditure (Kcal/min) were not statistically different between any of the post-exercise drinks.
  - Previous studies on post-exercise meal consumption showed inconsistent results on metabolic status (Stiegler, Sparks, & Cunliffe, 2008, Long, Wells, Englert, Schmidt, Hickey, & Melby, 2008).

- There were no significant interactions between time and energy drink type.
Conclusions

- Overall, testing indicates type of post-exercise drink does not significantly impact post-exercise oxygen consumption, substrate utilization, or energy expenditure in recreationally active males.

  - Additional study with more subjects of varying demographics would be useful in further elucidating post-exercise metabolic status.
Implications

- Weight Control = additional calories and additional cost without increased metabolic rate or increased fat metabolism

- Exercise Performance = no differences seen in immediate tests via indirect calorimetry
  - further study needed to determine effects on glycogen storage at molecular level
Acknowledgements

- Dr. H. Scott Kieffer
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- Honors Program
Sources


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Questions???