Recovery Nutrition: Review and Application

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Is Chocolate Milk the answer?

Despite an equivalent carbohydrate content between chocolate milk and CR, and less carbohydrate in FR, subjects cycled 49% and 54% longer following chocolate milk.

Figure 1 — Time to exhaustion and total work performed during the endurance performance trial following ingestion of three different recovery drinks. *Significantly different from carbohydrate replacement drink (P < 0.05).
Is Chocolate Milk the answer?


- **PROS**
  - Study focused on trained athletes (male cyclists)
  - Assessed recovery time with limited amount of recovery time (4 hours)
  - Assessed maximal exertion and time to exhaustion

- **CONS**
  - Biased funding group: Dairy and Nutrition Council, Inc.
  - Study was not Isocaloric (Recovery solutions yielded different calorie amounts)
# Chocolate Milk’s vs _______

<table>
<thead>
<tr>
<th></th>
<th>Whole Milk (3.25%)</th>
<th>Partly Skimmed (2%)</th>
<th>Partly Skimmed (1%)</th>
<th>Skim Milk (0.1%)</th>
<th>Chocolate Milk, Partly Skimmed* (2%)</th>
<th>Gatorade Thirst Quencher®</th>
<th>Gatorade Endurance Formula®</th>
<th>Accelerade®</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>159</td>
<td>128</td>
<td>108</td>
<td>90</td>
<td>189</td>
<td>52</td>
<td>53</td>
<td>85</td>
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<tr>
<td>kJ</td>
<td>663</td>
<td>536</td>
<td>453</td>
<td>380</td>
<td>793</td>
<td>218</td>
<td>221</td>
<td>354</td>
</tr>
<tr>
<td>PRO (g)</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>4</td>
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<tr>
<td>FAT (g)</td>
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<td>5</td>
<td>3</td>
<td>trace</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CHO (g)</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>13</td>
<td>27</td>
<td>15</td>
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<td>16</td>
</tr>
<tr>
<td>Na (mg)</td>
<td>126</td>
<td>129</td>
<td>129</td>
<td>133</td>
<td>159</td>
<td>115</td>
<td>211</td>
<td>127</td>
</tr>
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</table>
Simple Questions to ask to tailor Recovery Nutrition Needs

- What needs to be recovered after the training session?
- What nutrients will promote this recovery and how much do I need?
- What foods and drinks are suitable to provide these nutrients?
What dictates your recovery nutrition needs?

- **Physiological Needs for recovery**
  - Fuel store replenishment? CARBOHYDRATE
  - Replace fluid loss? HYDRATION
  - Muscle recovery? PROTEIN

- **Performance/Composition Goals**
  - Increased muscle growth? Prolonged aerobic activity?
  - Decreased fat mass?
  - Performance expectations with little recovery time?

- **Accessibility to food and preparation materials**
  - Naturally found foods vs. sports nutrition products
The Car Theory

Gasoline vs. Hardware vs. Oil
Physiological Needs

- Glycogen repletion (Gasoline)
  - The stored form of carbohydrate
  - Carbohydrate equals energy
  - Within the first 30-60 minutes, CHO ingestion recommended to increase resynthesis rate

Effect of Timing on Glycogen Resynthesis


- The time of ingestion of carbohydrate supplementation was examined.

- After 70 minutes of “intensive” training, a carbohydrate solution was provided either immediately following activity (P-Ex) or 2 hours following activity (2P-Ex). 2g CHO/kg body wt was provided both times

- Results: Rate of glycogen storage was 3x greater immediately after exercise than it was 2 hours after the completion of activity

- Despite elevated plasma glucose and insulin with supplementation 2 hours post activity, a slower rate of glycogen storage was seen when compared to immediate supplementation
Results

![Graph showing muscle glycogen storage during first 2 h and second 2 h of recovery for postexercise (P-EX) treatment (C) and the 2-h postexercise (2P-EX) treatment (■). * Significantly different from basal rate of synthesis which is represented by glycogen synthesis rate during first 2 h postexercise of treatment 2P-EX. † Significantly different from treatment 2P-EX during second 2 h of recovery (P < 0.05).]
Carbohydrate Ingestion for Recovery: Additional thoughts

- Higher glycemic index sugars increase glycogen storage (glucose vs. fructose)
- With shortened time for recovery, how much is needed to maximize glycogen synthesis?

![Graph showing muscle glycogen synthesis rate vs. carbohydrate intake.](image)
Physiological Needs

• Protein for Maintenance (Car: Gears, Pistons, etc. under the hood)

• High intensity activity breaks down muscle fibers

• Dietary protein provides building blocks for the maintenance, growth and repair of muscle fibers

• Protein with carbohydrate can increase insulin levels and activate further glycogen synthesis

• Intense training periods increase muscle breakdown
  • Ingestion of protein is necessary, but does timing of ingestion increase absorption??
AA Infusion Studies

- Rate of infusion is *saturable* after which a higher rate does not lead to greater synthesis.
  - Surprisingly small doses are effective (~ 6-10 g)
  - Extracellular AA concentration regulates muscle protein synthesis

- Infusion of AA has a *transient* response on PRO synthesis after which continued infusion does not lead to continued synthesis.
  - Multiple small feedings probably more effective than large bolus feeding

Bohe, 2003
Bohe, 2001
Maximizing Protein Synthesis After Exercise: two important facts

**Saturable Response**
More is not better...

**Transient Response**
Multiple small servings can stimulate PRO synthesis...

Not drawn to scale
Macronutrient Mix and Post-Exercise net Protein Balance

Most studies are done with small amounts of PRO & CHO

Net Protein Balance

+ Protein Synthesis

- Protein Breakdown

PLA CHO

EAA MAA EAA CHO EAA CHO LEU

EAA: Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, Valine
Coingestion of Protein + Carbohydrate


• Stimulates skeletal muscle protein synthesis in humans and improves whole body nitrogen balance

• Comparison of (3 hours post exercise): 
  • 1.2 g CHO/kg/hr
  • 1.2 g CHO/kg/hr + 0.4 g PRO/kg/hr
  • 1.6 g CHO/kg/hr

• Glycogen resynthesis did not change between trials

• Synthetic rate was significantly higher in CHO+PRO than the other two samples.
Study Results

**Fig. 4.** Mixed muscle protein fractional synthesis rate (FSR) from prolonged exercise while ingesting either 1.2 g CHO·kg⁻¹·h⁻¹ (L-CHO), 1.6 g CHO·kg⁻¹·h⁻¹ (H-CHO), or 1.2 g CHO·kg⁻¹·h⁻¹ (PRO-CHO). Values are means ± SE; n = 6. *P < 0.05 vs. other treatments at the same time point, †P < 0.05 vs. 4 h in the same trial. §§Main effect for treatment, P < 0.05. §§Main effect for time, P < 0.05.

**Fig. 3.** Whole body leucine oxidation (A) and net balance (B) during recovery from prolonged exercise while ingesting either 1.2 g CHO·kg⁻¹·h⁻¹ (L-CHO), 1.6 g CHO·kg⁻¹·h⁻¹ (H-CHO), or 1.2 g CHO·kg⁻¹·h⁻¹ (PRO-CHO). Values are means ± SE; n = 6. *P < 0.05 vs. other treatments at the same time point, †P < 0.05 vs. 4 h in the same trial. §§Main effect for treatment, P < 0.05. §§Main effect for time, P < 0.05.

**Fig. 5.** Muscle glycogen concentration over 4 h of recovery from prolonged exercise while ingesting either 1.2 g CHO·kg⁻¹·h⁻¹ (L-CHO), 1.6 g CHO·kg⁻¹·h⁻¹ (H-CHO), or 1.2 g CHO·kg⁻¹·h⁻¹ (PRO-CHO). Values are means ± SE; n = 6. §§Main effect for time, P < 0.05. dw, dry wt.
Physiological Needs

- Rehydration *and* Anti-oxidents (Car: Motor Oil)
- As little as a loss of 2% body weight can lead to:
  - Decreased muscle strength
  - Decreased anaerobic work capacity
  - Decreased aerobic work capacity
  - Decreased alertness
  - Decreased movement acuity
  - Decreased cardiac stroke, and increased heart rate
- Many athletes begin training in a Dehydrated state
Immune Suppression Post-Training

- Training at high intensities and volumes compromises immune system
  - Stress promotes training adaptation
- Carbohydrate depletion and energy depletion increases stress and suppresses immune function
- Choose nutrition-rich foods during this recovery eating time frame
- Fruit and other energy dense foods are optimal for recovery
Physiological Needs

• Rehydration: When body weight is lost in the form of fluid during an intense training session:
  • Replenish by replacing losses 150% (24 fl oz per pound body weight loss)
  • Drinking what is lost is not enough: Continued perspiration and urine production requires overcompensation
  • Monitor urine status to cater to changes of environment, exercise intensity, and prior hydration status before activity
  • Added sodium will aid in retention of fluid
  • Carbohydrate will speed up absorption
What can be done?

Review

- Carbohydrate as soon as possible post activity to increase rate of recovery
- ~1.0g CHO/kg/hr to optimize recovery time
- Include protein to enhance insulin response and increase muscle glycogen and enhance muscle repair (as little as 10g of PRO)
- Rehydration is just as important and can serve as a shuttle for carbohydrates during recovery
- Nutrient Dense food choices to boost immune system
## Recovery Nutrition Ideas

<table>
<thead>
<tr>
<th>Natural Foods</th>
<th>Sports Nutrition Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-fat Chocolate Milk</td>
<td>Clif Bar</td>
</tr>
<tr>
<td>Half of a bagel with fruit preserves</td>
<td>Powerbar Performance Bar</td>
</tr>
<tr>
<td>Low-Fat Yogurt with cereal/fruit</td>
<td>Endurox</td>
</tr>
<tr>
<td>Cereal with low-fat milk</td>
<td>PowerBar Recovery Drink</td>
</tr>
<tr>
<td>Peanut Butter and Jelly Sandwich</td>
<td>First Endurance Bar</td>
</tr>
<tr>
<td>Fruit Smoothie (yogurt, fruit, protein)</td>
<td>Liquid Meal Supplement (Boost, Ensure)</td>
</tr>
<tr>
<td>Turkey Sandwich</td>
<td></td>
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</tbody>
</table>
Thank you...

...Questions?