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BRIDGING THE GAP
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Nutritional Supplementation for Aerobic Training in Men and Women

Supplements discussed in this presentation are supported by:

- International Society for Sports Nutrition (ISSN)
- International Olympic Committee (IOC)
- American College of Sports Medicine (ACSM)
Aerobic Training

• “Any activity that uses large muscle groups, can be maintained continuously, and is rhythmic in nature.”
  – ACSM

• Examples:
  – Running
  – Cycling
  – Swimming
  – Rowing
Ergogenic Aid

• An ergogenic aid is any training technique, mechanical device, nutritional practice, pharmacological method, or psychological technique that can improve exercise performance capacity and/or enhance training adaptations.”

— ISSN
Assessment of Aerobic Performance

• Commonly used indices:
  – VO$_2$ Max
  – Gas Exchange Threshold (GET)
  – Physical Working Capacity at the Fatigue Threshold ($\text{PWC}_{\text{FT}}$)
  – Time to Exhaustion (TTE)
  – Time Trial (TT)
Mechanisms of Fatigue

Performance

Energy

Excitation

Contraction

Edwards’ (7) three-dimensional model “catastrophe theory”
Nutritional Supplementation

• Energy
  – Carbohydrate
  – Protein
  – Caffeine
  – Creatine

• Excitation Contraction
  (alkalizing agents)
  – Beta Alanine
  – L-Arginine
  – Sodium Bicarbonate
Energy – Carbohydrates

• Sources
  – Grains, beans, fruits, vegetables, sports drinks

• Physiological Responses (1, 2, 14, 17)
  – Increase muscle and liver glycogen stores
  – Maintenance of blood glucose
Energy – Carbohydrates

• Recommended Dosage
  – 55-65% of total calories
  – 5-12 g·kg BW·day

• Timing Considerations (18)
  – Pre Exercise
    • 3-4 hrs before 1-2 g·kg BW
  – During
    • 30-60 g·hr
  – Post Exercise
    • 1.0-1.5 g·kg BW

<table>
<thead>
<tr>
<th>Food</th>
<th>Serving</th>
<th>Carbs (grams)</th>
<th>Fiber (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Avocado (raw)</td>
<td>1 medium</td>
<td>7.1</td>
<td>1.1</td>
</tr>
<tr>
<td>2. Artichoke</td>
<td>1 medium</td>
<td>14.3</td>
<td>10.3</td>
</tr>
<tr>
<td>3. Raspberries (raw)</td>
<td>1 cup</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>4. Blackberries (raw)</td>
<td>1 cup</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>5. Lentils</td>
<td>1/2 cup</td>
<td>9.9</td>
<td>7.9</td>
</tr>
<tr>
<td>6. Black Beans</td>
<td>1/2 cup</td>
<td>22</td>
<td>7.3</td>
</tr>
<tr>
<td>7. Broccoli</td>
<td>1 cup</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>8. Soup, Vegetable Beef*</td>
<td>1 cup</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td>9. Pear (raw)</td>
<td>1 medium</td>
<td>20</td>
<td>4.5</td>
</tr>
<tr>
<td>10. Apple (raw)</td>
<td>1 medium</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>11. Oatmeal</td>
<td>1 cup</td>
<td>27</td>
<td>4</td>
</tr>
<tr>
<td>12. Barley</td>
<td>1/2 cup</td>
<td>22</td>
<td>3</td>
</tr>
<tr>
<td>13. Pumpkin</td>
<td>1 cup, mashed</td>
<td>12</td>
<td>2.9</td>
</tr>
<tr>
<td>14. Spinach</td>
<td>1 cup</td>
<td>3.3</td>
<td>2.5</td>
</tr>
<tr>
<td>15. Eggplant</td>
<td>1/2 slice</td>
<td>8</td>
<td>2.3</td>
</tr>
<tr>
<td>16. Summer Squash</td>
<td>1/2 cup</td>
<td>4</td>
<td>1.9</td>
</tr>
<tr>
<td>17. Peach (raw)</td>
<td>1 medium</td>
<td>12</td>
<td>1.8</td>
</tr>
<tr>
<td>18. Grapefruit (raw)</td>
<td>1/2 cup sections</td>
<td>10</td>
<td>1.5</td>
</tr>
<tr>
<td>19. Tofu, Firm</td>
<td>1/5 pkg.</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>20. Cauliflower</td>
<td>1/2 cup</td>
<td>2.7</td>
<td>1.3</td>
</tr>
<tr>
<td>21. Asparagus</td>
<td>4 spears</td>
<td>2.5</td>
<td>1.2</td>
</tr>
<tr>
<td>22. Cabbage</td>
<td>1/2 cup, shredded</td>
<td>3.9</td>
<td>1.2</td>
</tr>
<tr>
<td>23. Popcorn</td>
<td>1 cup</td>
<td>6.1</td>
<td>1.2</td>
</tr>
<tr>
<td>24. Arugula (raw)</td>
<td>1 cup</td>
<td>2.9</td>
<td>1</td>
</tr>
<tr>
<td>25. Olives*</td>
<td>10 olives</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Energy – Carbohydrates

• Performance Measures
  – TTE \(^{(5, 15, 19, 30)}\)
  – TTE, TT, and \(\text{VO}_2\) max \(^{(22)}\)
Energy – Protein

• Sources
  – Meat, eggs, milk, yogurt, whey protein, beans

• Physiological Responses (1, 2, 14, 17)
  – Muscle building and repair
  – Glycogen-sparing effect
Energy – Protein

• Recommended Dosage
  – 1.2-1.8 g·kg BW
  – Post Exercise
    • 0.2-0.5 g·kg BW
    • Ratio 3-4: 1 carbohydrate to protein

• Performance Measures
  – TTE (11, 21)
  – TT (8)
Energy – Protein

• Essential Amino Acids (EAA) \((1, 2, 14, 17)\)
  – 3-6 grams post exercise increases muscle protein synthesis

• Branched Chain Amino Acids (BCAA) \((1, 2, 14, 17)\)
  – 6-10 grams during exercise may improve psychological perception of fatigue
Energy – Creatine

• Sources
  – Meats including beef, salmon, and tuna

• Physiological Responses \((1, 2, 14, 17)\)
  – Facilitates synthesis of ATP
  – Maintenance of body weight during competitive season
Energy – Creatine

• Effective Dosage
  – Loading
    • 20 g·day for 5 days
  – Maintenance
    • 2-5 g·day thereafter

• Performance Measures
  – GET \(^{(9)}\)
  – \(PWC_{FT}^{(23)}\)
  – Glycogen-sparing and decreased protein degradation \(^{(25)}\)
Energy – Caffeine

• Sources
  – Cocoa beans, kola nuts, tea leaves, and coffee beans

• Physiological Responses (1, 2, 14, 17)
  – Central nervous system stimulant (reaction time)
  – Increased fatty acid metabolism (glycogen-sparing)
  – Euphoria
Energy – Caffeine

- Effective Dosage
  - 3-9 mg·kg BW

- Performance Measures
  - TTE \(^{(6,12)}\)
  - TT \(^{(10, 13)}\)
Energy – Summary

• Carbohydrate
  – TTE, TT, and VO$_2$ max ($5, 15, 19, 22, 30$)

• Protein
  – TTE and TT ($8, 11, 21$)

• Creatine
  – PWC$_{FT}$ and GET ($9, 23, 25, 32$)

• Caffeine
  – TTE and TT ($6, 10, 12, 13$)
Alkalizing Agents – Beta Alanine

• Sources
  – Chicken, beef, pork, and fish

• Physiological Responses (1, 2, 14, 17)
  – Intracellular buffer of hydrogen ions
Alkalizing Agents – Beta Alanine

• Effective Dosage
  – 2.4-6.0 g·kg BW

• Performance Measures
  – $\text{PWC}_{\text{FT}}^{(20)}$
  – $\text{PWC}_{\text{FT}}$ and VT $^{(24)}$
Alkalizing Agents – L-Arginine

• Sources
  – Fish, chicken, beef, lamb, milk, cheese, beans

• Physiological Responses (1, 2, 14, 17)
  – Precursor to nitric oxide (NO) - vasodilator
  – Increased blood perfusion to active muscles
Alkalizing Agents – L-Arginine

- **Effective Dosage**
  - 1.5-3.0 g·day

- **Performance Measures**
  - $\text{PWC}_{FT}$ and VT \([3, 4, 31]\)
Alkalizing Agents – Sodium Bicarbonate

• Sources
  – Baking soda – baked goods, supplements

• Physiological Responses (1, 2, 14, 17)
  – Extracellular buffer of hydrogen ions

\[ \text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{CO}_3 \rightleftharpoons \text{HCO}_3^- + \text{H}^+ \]

- carbon dioxide + water
- carbonic acid
- bicarbonate + hydrogen ion
Alkalizing Agents – Sodium Bicarbonate

• Effective Dosage
  – 0.3 g·kg BW 60-90 minutes prior to exercise

• Performance Measures
  – TTE \(^{(16)}\)
Alkalizing Agents – Summary

- Beta Alanine
  - $PWC_{FT}$ and GET $^{(20, 24)}$
- L-Arginine
  - $PWC_{FT}$ and GET $^{(3, 4, 31)}$
- Sodium Bicarbonate
  - TTE $^{(16)}$
Gender-Specific Considerations

• Metabolic Differences (26-28)
  – Women oxidize fat more readily
  – Men and women respond differently to carbohydrate loading
  – Men may require more protein than women
Gender-Specific Considerations

• Post Exercise Differences \(^{(29)}\)
  – Women experienced increased glucose, lactate, and insulin concentrations 30-min post exercise
  – Men experienced an increase in growth hormone 30-min post exercise, but decreased concentrations of IGF-1
Gender-Specific Summary

• Total energy intake
• Men may be more sensitive to:
  – Carbohydrate loading
  – Vasodilators
• Gender differences decrease with exercise duration (26, 28)
Take Home Message

- Energy
  - Carbohydrate
  - Protein
  - Creatine
  - Caffeine

- Excitation
  - Beta Alanine
  - L-Arginine
  - Sodium Bicarbonate

- Contraction

Performance
Take Home Message

• “No amount of supplementation will compensate for inadequate dietary intake”
  – ISSN

EAT A WHOPPER, LARGE FRY, & SODA....NO ONE BATS AN EYE
EAT GRILLED CHICKEN & BROWN RICE OUT OF TUPPERWARE & EVERYONE LOSES THEIR MINDS
References


