Sport Nutrition for the Runner

- General Body Physiology
- General Nutrition
  - Macronutrients (3 Major Fuels)
  - Food Choices
  - Proteins
  - Fats
- Pre Work-Out Fuel
- Fueling During Work-Outs
- Post Work-Out Fuel
- Weight vs. Body Composition
  - Energy IN versus Energy OUT
  - Weight versus Body Composition
Details Make Good Athletes Into Champions

• Recovery and Regeneration (including nutrition)
  – Ice baths, stretching, massage, chiro. etc.
• Drills, Circuits and Core
• Mental Status / Focus
  – Self-Esteem and Confidence
• Sleep Patterns
  – Importance of REM sleep = Inc. natural hGH
• Work-Out Partners
• Match Plan / Tactics
• Goal Setting
• Emotional / Psychological Support System

NUTRITION AND HYDRATION
Sport Nutrition for the Runner

- General Body Physiology -
1. Creatine-Phosphate System (C-P System)

2. Anaerobic System (Glycolytic)

3. Aerobic System (Oxidative)

*Figure 1.28* The essence of metabolism. Available fuels are broken down, and the energy resulting is stored as a usable form (ATP) for purposes such as skeletal muscle tension generation and thus the production of movement.

- from Martin and Coe: Training Distance Runners
Body Energy Stores of a 155 pound (~70kg) person

<table>
<thead>
<tr>
<th>Type of Energy</th>
<th>Stored Energy (kJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle glycogen</td>
<td>7000</td>
</tr>
<tr>
<td>Liver glycogen</td>
<td>2000</td>
</tr>
<tr>
<td>Adipose tissue (fat)</td>
<td>275000</td>
</tr>
<tr>
<td>Muscle Triglycerides (fat)</td>
<td>5500</td>
</tr>
</tbody>
</table>
Fuel Utilization at Different Exercise Intensities

25% VO2max
(Brisk Walking Pace)

65% VO2max
(~Marathon Pace)

85% VO2max
(~5 to 10km race pace)

- Fats
- Muscle Glycogen
- Blood Glucose (sugar)

- 30 min of exercise after an overnight fast:
Sport Nutrition for the Runner

- General Nutrition -

- 3 major macronutrients -
  - Calories -
  - Food Choices -
  - Proteins -
  - Fats -
General Dietary Info

• Dietary studies of runners show that they eat very similar to the normal population which is about 50% CHO, 30-35% from FAT and 15-20% from protein.
  – Therefore most need to make an effort to try and hit 55-60% CHO and cut down on poor fat choices / calories (more on good fat later…)

• Runners just NEED to eat more, especially during peak training season:
  – Men in excess of 3800 kcal’s (calories)
  – Women in excess of 3000 kcal’s (some more depending on body size)

• Major nutritional concern for athletes is that the excess energy they burn during training needs to be replaced by increased consumption or there will be a reduction in training capacity and increases in injury.
3 Major Macronutrients or ‘FUEL’s’

Carbohydrates - fruits, veggies, grains
- Sugars
- Starch’s (sugars linked together)
- Fiber (not broken down by the body)

Proteins - meat, milk, grains, legumes
- Provides structure and regulates many body processes
- Essential and non-essential Amino Acids (A.A.)

Fats - fats and oils
- Major storage form of energy in body
- Made of FFA’s, some are essential in diet
Periodize Nutrition to Match Periodization of Training and Competition

• Caloric intake needs to change throughout the training and competition year
  • Eat more when you train more, eat less when you’re in transition
  • Try and maintain, or be close to, your ‘ideal’ running body composition.

• Types of macronutrients needs to change throughout the training and racing year
  • Base training = longer runs = inc. fat burning = slight inc. fat intake
  • Peak training = intense workouts = inc. carb. Burning = inc. carb. Intake
Be a ‘grazer’

- Break-up large daily meals and caloric intake into smaller meals and healthy snacks every several hours.

- Helps maintain a constant supply of energy and maintain blood sugar throughout the day (no blood sugar ‘peaks’ and ‘valleys’).
Blood sugar when eating….

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Blood sugar [mM]</th>
</tr>
</thead>
<tbody>
<tr>
<td>8AM</td>
<td>4mM</td>
</tr>
<tr>
<td>12noon</td>
<td>5mM</td>
</tr>
<tr>
<td>8PM</td>
<td>6mM</td>
</tr>
</tbody>
</table>

Blood sugar [mM] ranges from 2mM to 6mM.
Choosing Foods Wisely…
the Carrier Method *

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Quality Carriers</th>
<th>Empty Carriers</th>
<th>Pollutant Carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Cargo</td>
<td>&quot;Motor Yacht&quot;</td>
<td>&quot;Rowboat&quot;</td>
<td>&quot;Garbage Barge&quot;</td>
</tr>
<tr>
<td>Vitamins, Minerals</td>
<td>Phytochemicals</td>
<td>Minimal amounts of beneficial nutrients</td>
<td>High amounts of harmful pollutants such as sat. fat, trans-fat</td>
</tr>
<tr>
<td>Antioxidants, Fibre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td>Whole-grain cereals/breads</td>
<td>cola</td>
<td>pork rinds</td>
</tr>
<tr>
<td>salmon</td>
<td>sweet potatoes</td>
<td>low-fat candy</td>
<td>high-fat candy (most bars)</td>
</tr>
<tr>
<td>kiwi fruit</td>
<td></td>
<td>kool-aid / 'fake' juices</td>
<td>doughnuts</td>
</tr>
<tr>
<td>lean beef</td>
<td></td>
<td>pretzels</td>
<td>lard</td>
</tr>
<tr>
<td>brown rice</td>
<td></td>
<td>low-fat cookies</td>
<td>french fries (anything fried)</td>
</tr>
<tr>
<td>fortified soy milk</td>
<td></td>
<td>iceberg lettuce</td>
<td>fried chicken</td>
</tr>
<tr>
<td></td>
<td></td>
<td>white rice/breads</td>
<td>high-fat meats (pork ribs)</td>
</tr>
</tbody>
</table>

* Adapted from Eat Right to Train Right by Chris Carmichael
General Food Choice Themes

• Generally speaking, most fresh, natural foods are quality carriers.
  – Fresh fruits, vegetables, nuts, whole-grains, and lean cuts of meat, chicken and fish.

• Natural foods loose quality as they are processed into convenience-orientated pre-packaged foods.
  – Ie. A fresh peach is way better than canned peaches

• Some quality carriers are doomed by the way they are cooked and prepared
  – Anything pre-packaged as breaded and/or fried
Fat shouldn’t be demonized

• Training increases bodies ability to use fat as a fuel source (large amounts in storage)

• IMTG (intra-muscular triglyceride) store replenishment?

• Need fat to absorb Vitamin A, D, E, K

• BUT don’t want to over eat fat (only need 40-120 g day depending on body size)
  – Look for mono and poly-unsaturated fat
    • Fats from vegetable sources, like avocados and nuts, contain none of the cholesterol found from animal sources
    • Fats found in cold water fish great!
      – Omega 3 and 6 fatty acids
  – BAD FATS: saturated and hydrogenated (trans fat)
Dietary Protein Recommendations for Elite Athletes
(whether you are a power lifter or a tiny distance runner!)

• Depending how much you train, you may need slightly more protein in your diet compared to the normal person

• Non Athletes
  – 0.8 grams of protein / kg B.W. /day

• Recreational to Amateur (ie. 4-5 workouts per week at 30min per workout)
  – 1.0 grams of protein / kg B.W. / day

• Elite Athletes (ie. 5-7 workouts per week at 60min+ each)
  – 1.3 to 1.7 grams of protein / kg B.W. / day
## How much protein do you need?

<table>
<thead>
<tr>
<th>Weight (Pounds)</th>
<th>kg</th>
<th>Daily Protein Req. (grams / day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125</td>
<td>57</td>
<td>96</td>
</tr>
<tr>
<td>150</td>
<td>68</td>
<td>116</td>
</tr>
<tr>
<td>175</td>
<td>80</td>
<td>135</td>
</tr>
<tr>
<td>200</td>
<td>91</td>
<td>154</td>
</tr>
<tr>
<td>225</td>
<td>102</td>
<td>173</td>
</tr>
<tr>
<td>250</td>
<td>114</td>
<td>193</td>
</tr>
</tbody>
</table>
Probably less protein than you think you need…

<table>
<thead>
<tr>
<th>Meal</th>
<th>Sample Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td>2 slices whole wheat toast with peanut butter</td>
</tr>
<tr>
<td></td>
<td>1 cup of oatmeal with 1 cup of lowfat milk</td>
</tr>
<tr>
<td></td>
<td>1 banana and 1 cup of orange juice</td>
</tr>
<tr>
<td>Lunch</td>
<td>1 ham and cheese sandwich on whole grain bread</td>
</tr>
<tr>
<td></td>
<td>1 cup of vegetable and bean soup</td>
</tr>
<tr>
<td></td>
<td>1 cup of fresh fruit salad</td>
</tr>
<tr>
<td></td>
<td>1 small fast food milkshake</td>
</tr>
<tr>
<td>Post Work-out</td>
<td>1 energy bar</td>
</tr>
<tr>
<td>Out Snack</td>
<td>16 ounces of apple juice</td>
</tr>
<tr>
<td>Dinner</td>
<td>6 ounces grilled skinless, boneless chicken breast</td>
</tr>
<tr>
<td></td>
<td>1 cup of pasta tomato sauce</td>
</tr>
<tr>
<td></td>
<td>1 cup steamed broccoli</td>
</tr>
<tr>
<td></td>
<td>2 cups lowfat milk</td>
</tr>
</tbody>
</table>

This sample meal plan provides 175 grams of protein… enough for a 225 pound athlete!
- Therefore for daily protein intake requirements, buying extra protein powders are often unnecessary.
- Can be ‘handy’ for immediate post-workout recovery and regeneration (anabolism) (more on this later)
Foods to Ponder: Common Protein Contents in Certain Foods

Meat Sources

BBQ Chicken (light) = 26g

1 slice of lean roast beef = 41g
1 slice of lean steak = 28g (only 2-3 grams of sat. fat)

Full steak = 50-70g
½ pound of ground beef = 20g
Most fast food restaurant burger = ~26g but 17g of sat. fat
Roast beef sub = 30g
Most fish = 30-40 g (and most sat. fat under 3g)

Non-meat Sources

1 cup backed beans = 12g
1 cup garbanzo beans = 41g
Fortified Breakfast Cereals = 3-5g
Candy Bar = 6g (but 33g of carbs and 13g of fat)
1 cup of shredded cheddar = 28g of protein (but 24g sat. fat)
1 cup of low fat cottage cheese = 30g of protein (but only 7g of sat. fat)
1 cup of tofu = 40g of protein
1 cup cooked lentils = 18g

Remember: compared to skinless chicken breast, the same amount of lean beef has only 1 more gram of saturated fat, and 6-times more zinc, 3-times more iron and 8-times more vitamin B12.

Just something to think about…
Sport Nutrition for the Runner

- Pre Work-Out Fuel -
NOT THIS:

Crash and Burn in Practice or Competition
Effects of Diet on Pre-Exercise Levels of Glycogen and Performance

Carbohydrate is your high octane fuel

<table>
<thead>
<tr>
<th>Type of Diet for 3-days Prior to Exercise</th>
<th>Initial Muscle Glycogen (g/100g)</th>
<th>Cycle Time (min) to Exhaustion at 75% of max</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Fat/Protein (~10-15% Carbs)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Normal Mixed Diet (~50% Carbs)</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>Carb. Rich Diet (~65-70% Carbs)</td>
<td>4</td>
<td>150</td>
</tr>
</tbody>
</table>

(data from Bergstrom et.al., 1967)
Pre Work-Out and Competition Meal Tips

Pre Exercise/Competition Meals Vital!

<table>
<thead>
<tr>
<th>Good Foods for Pre-Comp</th>
<th>Bad Foods for Pre-Comp</th>
</tr>
</thead>
<tbody>
<tr>
<td>High carbohydrate, moderate protein and low fat</td>
<td>High fat, and/or protein low carbohydrate, low calorie</td>
</tr>
<tr>
<td>pasta, rice, potatoes, sandwiches</td>
<td>steak, bacon, sausage, ice cream</td>
</tr>
<tr>
<td>bagels, oatmeal, cereals, certain</td>
<td>certain salads, diet soft drinks</td>
</tr>
<tr>
<td>fruits</td>
<td></td>
</tr>
</tbody>
</table>

Timing is also very important

- **3 to 4 hours** before a smaller meal is suitable such as:
  - whole grain bagel, with peanut butter and jelly, banana, juice and sports drink
- **1 to 2 hours** before another snack is suggested such as:
  - bar with 300-500ml of sports drink or juice with crackers, yogurt with nuts and raisins w/ sports drink
- Hour before competition : just stick with water
### Fueling for Tournaments

<table>
<thead>
<tr>
<th>Time</th>
<th>Sample Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6:30 AM</strong></td>
<td>Oatmeal with lowfat milk, Breakfast banana and orange juice</td>
</tr>
<tr>
<td><strong>8:30AM</strong></td>
<td>FIRST COMPETITION</td>
</tr>
<tr>
<td><strong>9:00AM</strong></td>
<td>Granola Bar and orange slices</td>
</tr>
<tr>
<td><strong>Snack</strong></td>
<td>sports drink</td>
</tr>
<tr>
<td><strong>10:30AM</strong></td>
<td>SECOND COMPETITION</td>
</tr>
<tr>
<td><strong>11:00AM</strong></td>
<td>Turkey sandwich, with grapes</td>
</tr>
<tr>
<td><strong>Snack</strong></td>
<td>water</td>
</tr>
<tr>
<td><strong>1:00PM</strong></td>
<td>THIRD COMPETITION</td>
</tr>
<tr>
<td><strong>1:30PM</strong></td>
<td>Yogurt with graham crackers</td>
</tr>
<tr>
<td><strong>Snack</strong></td>
<td>lots of water and sports drink</td>
</tr>
<tr>
<td><strong>3:00PM</strong></td>
<td>FOURTH COMPETITION</td>
</tr>
<tr>
<td><strong>3:30PM</strong></td>
<td>Apple Juice</td>
</tr>
<tr>
<td><strong>Snack</strong></td>
<td></td>
</tr>
<tr>
<td><strong>4:30PM</strong></td>
<td>FINAL COMPETITION</td>
</tr>
<tr>
<td><strong>5:00PM</strong></td>
<td>Peanut butter and crackers with raisins</td>
</tr>
<tr>
<td><strong>Snack</strong></td>
<td>sports drink with protein powder</td>
</tr>
<tr>
<td><strong>6:30PM</strong></td>
<td>Grilled chicken breast with pasta and marinara sauce</td>
</tr>
<tr>
<td><strong>Dinner</strong></td>
<td>salad with lowfat dressing</td>
</tr>
<tr>
<td></td>
<td>green beans</td>
</tr>
<tr>
<td></td>
<td>low fat milk, lots of water</td>
</tr>
<tr>
<td></td>
<td>sorbet</td>
</tr>
</tbody>
</table>

Athletes must plan ahead to maintain and rebuild energy (glycogen) stores
Sport Nutrition for the Runner

- Fueling During Workouts -
Blood Glucose during CHO Supplementation to Fatigue

Blood sugar levels during exercise
(4 to 5 mM is normal range)

Range of hypoglycaemia
(low blood sugar)

CHO

Placebo

FATIGUE

Blood glucose (sugar) (mM)

Exercise Time in hours to Fatigue at 75% of max
with ingestion of carbohydrate (CHO)
every 20 min or water (placebo)

Adapted from Coyle et al., (1986)
So what does that all mean?

You should choose a sports drink that has:

- 6 to 8% carbohydrate solution
- Fructose and glucose mix (or sucrose)

You can only burn or use 1 gram of carbohydrate per min that you drink (regardless of the amount you drink) then you should shoot for:

\(\sim 60 \text{ grams of carbohydrate per hour when training hard}\)
Sport Nutrition for the Runner

- Post Work-Out Fuel -
Body Energy Stores of a 155 pound (~70kg) person

- Muscle glycogen: 7000 KJ
- Liver glycogen: 2000 KJ
- Adipose tissue (fat): 275000 KJ
- Muscle Triglycerides (fat): 5500 KJ
Optimal Goals for Fluid Ingestion **After** Training/Event

- Following workout, need to help body re-synthesize liver and muscle glycogen stores for the next workout/training session/race...

...even important for someone who is involved in multiple events and/or practices in a day as well as for Stop-&-Go sports. (not just endurance sports)

Attempt to replace lost fluids (sweat & urine) **within 2 hours** following event (~3-4 cups for each pound body weight lost) - OPTIMAL!!

Nutrition is also very important within the first 2 hours!
Muscle Glycogen Resynthesis with varying CHO Consumption

Shoot for 60 grams per hour in the first two hours post exercise


Supplementation is ~0.8 g/kg BW with 0.4 g/kg BW every hour.

Best amino acids to get insulin response: arginine, leucine and phenylalanine.

Taken from data from W.H. Saris, Luc J.C. Van Loon and A.E. Jeukendrup.
Optimal fueling IMMEDIATELY after work-out and competition.
Examples of Good Post-Exercise Carbohydrate

1 Litre of Gatorade = ~ 66 grams

1 Large Potato = ~50 grams
Lima Beans = ~50 grams
10 dried dates = ~50 grams
English Muffin = ~130 grams
1 cup of rice = ~50 grams
2/3 cup of raisins = ~75 grams

But what about adding protein?
Impact of a High versus Low Carbohydrate Diet on Glycogen Resynthesis
Sport Nutrition for Runner

- Weight Management -

- Weight vs. Body Composition –
- Energy IN vs. Energy OUT –
- Losing / Maintaining Weight: –
**Energy Inputs**
Nutrition / Hydration
- Carbs (~4 kcal / gram)
- Proteins (~4 kcal / gram)
- Fats (~9 kcal / gram)

**Energy Expenditure**
- BMR
- Activity Level
- TEF

**AIM for ENERGY IN = ENERGY OUT**
for optimal body composition (not weight per se)
12.8%  16.6%  12.1%  15.1%

AS LONG AS THE RUNNER IS WELL TRAINED AND LEAN, ALONG WITH USING PROPER NUTRITION AND HYDRATION PRACTICES, THEN SUCCESSFUL RUNNERS CAN COME IN ALL BODY SIZES!
#1 GOAL: Aim for ‘Optimal’ Body Composition

with ‘Optimal’ Body Physiology

before Championship Season

BEFORE Championship Season
- try to maintain ideal body composition all year (ie. No weight yo-yoing)
- if you gain a little, goal is to try losing fat weight (NOT lean muscle mass) over the duration of off/early season

DURING Championship Season
- achieve optimal body physiology within body weight
- well fueled and hydrated for optimal performance

HOW CAN YOU DO THIS?????
Be aware of large increases in serving sizes…

<table>
<thead>
<tr>
<th>Item</th>
<th>Portion Size</th>
<th>10-15 years ago</th>
<th>Calories</th>
<th>Current Portion</th>
<th>Size</th>
<th>Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chips</td>
<td>1-oz bag</td>
<td></td>
<td>150</td>
<td>2 oz 'grab bag'</td>
<td>2 oz</td>
<td>275</td>
</tr>
<tr>
<td>French Fries</td>
<td>McDonald's large</td>
<td></td>
<td>305</td>
<td>McDonald's large</td>
<td>6.2 oz</td>
<td>540</td>
</tr>
<tr>
<td></td>
<td>3.5 oz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-11 Soft Drinks</td>
<td>large 20 oz</td>
<td></td>
<td>225</td>
<td>Double Big Gulp</td>
<td>64 oz</td>
<td>720</td>
</tr>
<tr>
<td>Hamburger</td>
<td>5.7 oz</td>
<td></td>
<td>420</td>
<td>8.4 oz</td>
<td></td>
<td>600</td>
</tr>
</tbody>
</table>
## Fat free doesn’t necessarily mean low calorie!

<table>
<thead>
<tr>
<th>Fat-Free or Reduced Fat</th>
<th>Calories</th>
<th>Regular</th>
<th>Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced-fat peanut butter 2 tablespoons</td>
<td>187</td>
<td>Regular peanut butter 2 tablespoons</td>
<td>191</td>
</tr>
<tr>
<td>Reduced-fat chocolate chip cookies (3 cookies- 30g)</td>
<td>118</td>
<td>Regular chocolate chip cookies (3 cookies- 30g)</td>
<td>142</td>
</tr>
<tr>
<td>Non-fat vanilla frozen yogurt, 1/2 cup</td>
<td>100</td>
<td>Regular vanilla frozen yogurt</td>
<td>104</td>
</tr>
<tr>
<td>Low fat cereal bar</td>
<td>130</td>
<td>Regular cereal bar</td>
<td>140</td>
</tr>
</tbody>
</table>
Good Food Choices

Multi Grain Bagel

303 kcal
58 g carbs
12 g protein
3 g fat
Cream Cheese
140 kcal (13 g fat)

VS.

Chocolate Chip Muffin

440 kcal
68 g carbs
6 g protein
16 g fat
Good Food Choices

Medium Black Coffee

78 kcal
10 g carbs
0.6 g protein
4 g fat

VS.

Medium Iced Cappuccino

230 kcal
30 g carbs
2 g protein
11 g fat
Homemade Lean Hamburger

- About 500 kcal
- 45 g carbs
- 37 g protein
- 18 g fat

Double Whopper

- 1060 kcal
- 53 g carbs
- 56 g protein
- 69 g fat

VS.
Sport Nutrition for the Runner

- Creatine -
Creatine - How does it work?

Basic Unit of Energy:  ATP $\longrightarrow$ ADP + Pi

PCr + ADP + H+ $\xrightarrow{CK}$ ATP + Creatine

- The availability of PCr is generally accepted to be the most likely limitation to muscle performance during intense, fatiguing, short-lasting contractions.

- PCr resynthesis during recovery following a single bout of maximal exercise is positively correlated with the next bout of intense exercise.
BREAKDOWN OF THE 3 ENERGY SYSTEMS

- from Martin and Coe: Training Distance Runners
Fig. 27.3 Total muscle creatine concentration before and after 34 days of creatine ingestion. Creatine was ingested at a rate of 20 g·day⁻¹ for the initial 6 days and at a rate of 2 g·day⁻¹ thereafter.
High individual variability in increasing creatine

Fig. 27.2 Total muscle creatine concentration before and after different durations (3–21 days) of creatine ingestion at rates of 20 g · day⁻¹ (subjects KS, EH, RH, IS, SL and ES) and 30 g · day⁻¹ (subjects HL, HH, JS, JV, OO and AL). 21/2 indicates creatine was ingested every other day for a duration of 21 days. Adapted from Harris et al. (1992).
Sport Nutrition for the Runner

- Carbohydrates Effects on Sprints and Resistance Performance -
Carbohydrate before and during exercise improves high-intensity exercise capacity

Gatorade®
(a 6% carbohydrate beverage)

Water
(no carbohydrate energy)

Minutes of High-Intensity Cycling

Individuals undergoing 1-minute cycling sprints followed by 3 minutes of rest, continuously, until exhausted, were tested when consuming water or, when given a carbohydrate sports drink (Gatorade®).
Table 1. Effect of dietary carbohydrate on performance of resistance exercise.

<table>
<thead>
<tr>
<th>GLYCOGEN LOADING</th>
<th>SUBJECTS</th>
<th>RESISTANCE PROTOCOL</th>
<th>DIETARY TREATMENTS</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitchell et al. 1997</td>
<td>11 RT males</td>
<td>5 sets of 3 exercises to failure @ 15 RM</td>
<td>Exercise + HC (80%) or LC (4%) for 48h</td>
<td>No difference in volume lifted</td>
</tr>
<tr>
<td>Walberg et al. 1998</td>
<td>19 RT males</td>
<td>10 maximal-effort isometric contractions</td>
<td>7 d of hypoenergy diet (18 kcal/kg), either HC (70%) or MC (50%)</td>
<td>Reduced muscle endurance for MC; no change for HC</td>
</tr>
</tbody>
</table>

**ACUTE INGESTION**

| Dalton et al. 1999 | 22 RT males | 5 sets of 10 of 4 exercises @ 80%, 80%, 70%, 60%, 60%, 60% 1 RM | Energy restricted for 3 d, 1 g CHO or placebo/kg 30 min before exercise | No diet effect on number of repetitions for final set of bench press or leg extension |
| Lambert et al. 1991 | 7 RT males | 2 trials of repeated sets of 10 leg extensions @ 80% of 10 RM | Glucose polymer or placebo before and between sets | Number of sets tended to be > in CHO Number of reps tended to be > in CHO |

RT = resistance trained; HC = high carbohydrate; LC = low carbohydrate; MC = moderate carbohydrate; CHO = carbohydrate.

**Resistance Exercise** - NO substantial performance effect with CHO supplementation

<table>
<thead>
<tr>
<th>STUDY</th>
<th>SUBJECTS</th>
<th>EXERCISE PROTOCOL</th>
<th>DIET PROTOCOLS</th>
<th>EFFECT ON PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hall et al. 1996</td>
<td>6 active males</td>
<td>Cycle 4 times @ 95% VO₂ max to exhaustion</td>
<td>3-d diets MC (48%) or LC (2%) Supplement: CaCO₃ or NaHCO₃</td>
<td>26-31% lower exercise time for LC; no effect of supplement</td>
</tr>
<tr>
<td>Hargreaves et al. 1997</td>
<td>9 trained cyclists</td>
<td>75-s maximal cycle bout</td>
<td>Exercise + HC (80%) or LC (25%) for 24 h</td>
<td>No difference in peak or mean power</td>
</tr>
<tr>
<td>Langfort et al. 1997</td>
<td>8 males</td>
<td>30-s Wingate test</td>
<td>3 d of MC (50%) or LC (5%)</td>
<td>8% lower mean power for LC</td>
</tr>
<tr>
<td>Pitsiladis &amp; Maughan 1999</td>
<td>13 trained cyclists or triathletes</td>
<td>Cycle to exhaustion at 90% of VO₂ max</td>
<td>7 d of either HC (70%) or MC (40%)</td>
<td>No difference in time to exhaustion</td>
</tr>
<tr>
<td>Pizza et al. 1995</td>
<td>8 trained male runners</td>
<td>Run 15 min at 75% VO₂ max + run to exhaustion at 100% VO₂ max</td>
<td>MC (4 g/kg) or HC (8.2 g/kg) for 3 d</td>
<td>8% shorter exercise time for LC</td>
</tr>
<tr>
<td>Vandenberghe et al. 1995</td>
<td>17 female and 15 male fit students</td>
<td>Cycle @ 125% of VO₂ max until exhaustion</td>
<td>MC diet (50%) for 5 d with normal activity or MC for 2 d with exercise to deplete glycogen, then 3-d HC diet (70%)</td>
<td>No difference in performance</td>
</tr>
</tbody>
</table>

HC = high carbohydrate; LC = low carbohydrate; MC = moderate carbohydrate.

**NO real effect with CHO on single sprints**

Table 3. Effect of carbohydrate on repeated sprint performance.

<table>
<thead>
<tr>
<th>STUDY</th>
<th>SUBJECTS</th>
<th>EXERCISE PROTOCOL</th>
<th>DIETARY TREATMENTS</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLYCOGEN LOADING</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balsom et al. 1999</td>
<td>7 males fit students</td>
<td>Fixed duration: 15 min 6-s cycling sprints with 30 s between, -300% VO2 max; To exhaustion: 6-s spring @ -200% VO2 max</td>
<td>Glycogen depletion exercise + LC (4%) or HC (67%) for 2 d</td>
<td>Fixed duration: less work performed by LC to exhaustion; 265% more intervals performed by HC</td>
</tr>
<tr>
<td>Casey et al. 1996</td>
<td>11 males</td>
<td>4 bouts of 30-s isokinetic cycling with 4-min rest intervals (Before and after diet manipulation)</td>
<td>Glycogen depletion exercise + LC (7.8%) or HC (82%) for 3 d</td>
<td>No change in work performed pre vs. post diet for HC; work during first 3 sprints 8% less after LC</td>
</tr>
<tr>
<td>Jenkins et al. 1993</td>
<td>14 moderately trained males</td>
<td>Five 60-s cycle sprints @ 0.735 N/kg with 5 min rest intervals (Before and after each dietary manipulation)</td>
<td>3-d diets: HC 80%; MC 55%; LC 12%</td>
<td>Change in work performed during sprints: HC: +5.6%; MC: +2.3%; LC: -5.4%</td>
</tr>
<tr>
<td>Lamb et al. 1990</td>
<td>14 male collegiate swimmers</td>
<td>50 m x 20 100 m x 20 200 m x 15</td>
<td>9 d of HC (60%), or MC (43%)</td>
<td>No difference in average split time for HC vs. MC</td>
</tr>
<tr>
<td>Smith et al. 2000</td>
<td>8 trained cyclists</td>
<td>60-s repeated sprints @ 125%-135% VO2 max to 30% fatigue</td>
<td>Glycogen reduction; then 36 h HC (80-85%) or LC (5-10%)</td>
<td>37% longer exercise until 30% fatigue in HC; 87% longer between 15% and 20% fatigue in HC</td>
</tr>
<tr>
<td>ACUTE INGESTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Davis et al. 1997</td>
<td>9 men and 7 women, untrained</td>
<td>1-min cycling sprints @ 120-130% VO2 max with 3 min rest intervals until power output declined 12.5%</td>
<td>4 ml/kg of 6% CHO solution before and every 20 min during exercise</td>
<td>50% more intervals done with CHO than with placebo</td>
</tr>
</tbody>
</table>

HC, high carbohydrate; LC = low carbohydrate; MC = moderate carbohydrate; CHO, carbohydrate
Sport Nutrition for the Runner

- Beverage Comparisons -
# Gatorade Beverage Comparison Chart

## Ingredients per 8 oz.

<table>
<thead>
<tr>
<th>What to look for in a Sports Drink During Exercise</th>
<th>Carbohydrate Content (%)</th>
<th>Carbohydrate (g)</th>
<th>Carbohydrate Type</th>
<th>Calories</th>
<th>Sodium (mg)</th>
<th>Potassium (mg)</th>
<th>Carbonation</th>
<th>Caffeine</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 7% carbohydrate</td>
<td>Less than 7% carbohydrate</td>
<td>14g</td>
<td>Sucrose, Glucose Fructose</td>
<td>50 - 60 calories</td>
<td>At least 160mg</td>
<td>At least 28mg</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

### Sports Drinks

- **Gatorade**: 0%, 14g, Sucrose, Glucose, Fructose, 50, 110, 30, No, No
- **Accelerade**: 7%, 17g, Sucrose, Fructose, 93, 127, 43, Ne, No
- **AllSport**: 0%, 19-20g, High Fructose Corn Syrup, 70, 55, 55, Ne, No
- **CytoSport**: 8%, 19g, High Fructose Corn Syrup, Maltodextrin, 80, 50, 55, Ne, Yes (in some flavors)
- **Endurox R4**: 15%, 35g, Crystalline Fructose, Glucose, 187, 153, 93, Ne, No
- **Extran Thirst Quencher Mix**: 5%, 11g, Fructose, Maltodextrin, 45, 3.3, 2.8, Ne, No
- **Hydrate**: 4%, 10g, High Fructose Corn Syrup, 55, 91, 77, Ne, No
- **Hydrate Beverage Company**: 8%, 19g, Fructose, Glucose, 75, 125, 40, Ne, No
- **Met-RX**: 7%, 16g, Maltodextrin, Fructose, 133, 140, 200, Ne, Yes
- **Met-Rx, Inc.**: 8%, 19g, High Fructose Corn Syrup, Maltodextrin, 70, 55, 30, Ne, No
- **Pro-Hydrator**: 0%, 0g, Glycerol is primary ingredient (no carbohydrate), 0, 2.5, 4.5, Ne, No
- **Revenge**: 4.2%, 10g, Maltodextrin, Fructose, 59, 48, 80, Ne, Yes
- **Ultima**: 1.7%, 4g, Maltodextrin, 16, 8, 16, Ne, No

### Non Sports Drinks

- **Regular Cola**: Caffeinated, carbonated cola, 11%, 25g, High Fructose Corn Syrup, Sucrose, 95, 34, 0, Yes, Yes
- **Orange Juice**: 11%, 27g, Sucrose, Fructose, Glucose, 112, 7, 446, Ne, No
- **Pedialyte**: 2.2%, 6g, Glucose, Fructose, 24, 248, 188, Ne, No
- **Red Bull**: 11%, 27g, Glucose, Sucrose, 108, 207, 0, Yes, Yes
- **Rehydralyte**: 2.0%, 6g, Glucose, 24, 414, 186, Ne, No
- **Water**: 0%, 0g, None, 0, 0, 0, Ne, No
## Comparison of Several Sports Drinks Currently Sold
(per litre/33 fl oz)

<table>
<thead>
<tr>
<th></th>
<th>e-load</th>
<th>Gatorade™</th>
<th>Powerade™</th>
<th>Allsport™</th>
<th>Cytomax Orange™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium (mg)</td>
<td>740-1100</td>
<td>456</td>
<td>229</td>
<td>229</td>
<td>160</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>195-300</td>
<td>125</td>
<td>125</td>
<td>229</td>
<td>300</td>
</tr>
<tr>
<td>Sodium:Potassium Ratio</td>
<td>3.6:1</td>
<td>3.6:1</td>
<td>1.8:1</td>
<td>1:1</td>
<td>.53:1</td>
</tr>
<tr>
<td>MultiCitrate™ (mg)</td>
<td>1150-2190</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Carbohydrate</th>
<th>Dextrose</th>
<th>Sucrose</th>
<th>Fructose Glucose Polymers Maltodextrin</th>
<th>High Fructose Corn Syrup</th>
<th>Fructose Amylopect starch Maltodextr</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Carbohydrate</td>
<td>5.4 (in Base)</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Calories</td>
<td>216 (in Base)</td>
<td>240</td>
<td>320</td>
<td>320</td>
<td>280</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>50-90</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>50-120</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Zinc (mg)</td>
<td>10</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Osmolality (mOsm)</td>
<td>370 (in Base)</td>
<td>360</td>
<td>420</td>
<td>550</td>
<td>360</td>
</tr>
<tr>
<td>pH</td>
<td>4.1</td>
<td>2.95</td>
<td>2.75</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Vitamin C (mg)</td>
<td>300</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Vegetable Oils</td>
<td>No</td>
<td>Yes</td>
<td>?</td>
<td>?</td>
<td>No</td>
</tr>
<tr>
<td>Artificial Colors</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Artificial Flavors</td>
<td>No</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>Yes</td>
</tr>
<tr>
<td>Carbonation</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Sport Nutrition for the Runner

- Low Down on Energy Drinks -
The ‘Low-down’ on “ENERGY DRINKS” *

- Ingredients and doses are often NOT standardized, so it’s impossible to know exactly what is in the product.

- Many drinks do not contain exactly what is written the package, some even contain traces of banned substance (ie. nandrolone).

  (Gurley et. al., 2000; Am. J. of Health Systms. Pharm)

- Herbs have little or no regulatory control and have a potential for serious side effects if taken with prescribed medicine.

  (Izzo and Ernst, 2001; Drugs)

- Usually really costly!

- May even have too much of an ingredient that would cause a negative performance effect! (ie. TOO much CHO or caffeine)

* Sports Science Exchange; Vol 15(1); 2002
4 Major Energy Drink Examples *
(Prices in U.S. Dollars)

**RED BULL - $2.69**
Carbonated Water, Sucrose, Glucose, Sodium Citrate, Taurine 100mg, Glucuronolactone 600mg, Caffeine 80mg, Inositol 50.0mg, Niacin 20.0mg, Pantothentic acid 5.0mg, Vitamin B6 5.0mg, Vitamin B12 5.0ug, Flavors, Colors: Caramel & Riboflavin.

**ISO Sprint - $2.17**
Water, Sucrose, Maltodextrin, Lemon Concentrate, Citric Acid (E 330), Magnesium Carbonate, Kaliumcitrat, Natriumcitrate, Calciumlactate, L-cartinin, Vitamins, Natural Aroma. 6.2% Sacharides.

**Semtex Forte - $2.17**
Water, Sugar, Glucose, Citric Acid, Taurine (4000 mg/l), Carbon Dioxide, Caffeine (320 mg/l), Glucuronolactin (2400 mg/l), Inosit (200 mg/l), Vitamins, Colours: E 150, Riboflavin, Flavours (Aromatized).

**Erektus - $2.17**
Water, Sugar, Concentrated Aromatic Base, Contents of Guarana, Herb Extracts, Caffein (300 ml/l), Vitamins, Citric Acid, Taurine (4000 mg/l), L-camitine (320 mg/l), Flavours, Colour E124. (Aromatized).

* http://www.needmorebeer.com/energy.htm
What the consumer must ask oneself?

- Is the new ‘energy drink’ sound too good to be true? - Probably is!
- Does it have a nutritional or supplemental ingredient list? - If not, don’t even consider using it!
- Is there any well controlled, un-biased and published (peer reviewed credible journal) research done on the product?
- Avoid any herbal additives if your also on prescription medicine, as there may be adverse interactions that may occur.

- **FINALLY, is your current eating and lifestyle pattern already optimized for performance?** Why spend money on an expense energy drink, when you can make some easy, cost effective improvements first.
<table>
<thead>
<tr>
<th>Product</th>
<th>Energy (kcal/8 oz)</th>
<th>Carbohydrate (g/8 oz)</th>
<th>Additional Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona Extreme Energy Shot™</td>
<td>124</td>
<td>32</td>
<td>Caffeine, taurine, ribose, ginseng, carnitine, guarana, inositol, vitamins</td>
</tr>
<tr>
<td>Arizona Rx Energy™</td>
<td>120</td>
<td>31</td>
<td>Caffeine, ginseng, Schizandrae, vitamins</td>
</tr>
<tr>
<td>Battery Energy Drink™</td>
<td>114</td>
<td>27</td>
<td>Caffeine, guarana</td>
</tr>
<tr>
<td>Bawls Guarana™</td>
<td>96</td>
<td>27</td>
<td>Caffeine, guarana</td>
</tr>
<tr>
<td>Dynamite Energy Drink™</td>
<td>95</td>
<td>25</td>
<td>Caffeine, taurine, inositol, vitamins</td>
</tr>
<tr>
<td>Effervescent Glutamine Recovery Drink™</td>
<td>24</td>
<td>0.8</td>
<td>Glutamine, electrolytes</td>
</tr>
<tr>
<td>Gatorade Energy Drink™</td>
<td>203</td>
<td>52</td>
<td>Vitamins</td>
</tr>
<tr>
<td>G3 Endurance™</td>
<td>90</td>
<td>24</td>
<td>Galactose, protein, chromium, green tea, ginseng, vitamins, minerals</td>
</tr>
<tr>
<td>G4 Recovery™</td>
<td>110</td>
<td>27</td>
<td>Ginseng, galactose, green tea, vitamins, protein</td>
</tr>
<tr>
<td>Hansen's Energy™</td>
<td>107</td>
<td>31</td>
<td>Taurine, ginseng, caffeine, Ginkgo biloba, guarana, vitamins</td>
</tr>
<tr>
<td>Hansen's Stamdown™</td>
<td>0</td>
<td>0</td>
<td>Pyruvate, carnitine, vitamin C</td>
</tr>
<tr>
<td>Jones Whoop Ass Energy™</td>
<td>107</td>
<td>27</td>
<td>Caffeine, royal jelly, guarana, taurine, inositol, vitamins</td>
</tr>
<tr>
<td>Mad River Energy Hammer™</td>
<td>110</td>
<td>27</td>
<td>Guarana, ginseng, bee pollen</td>
</tr>
<tr>
<td>Nexite™</td>
<td>100</td>
<td>21</td>
<td>Guarana, damiana, Schizandrae, mate, ginseng, caffeine</td>
</tr>
<tr>
<td>Oxytime+ Sports Drink™</td>
<td>80</td>
<td>18</td>
<td>&quot;Stabilized oxygen,&quot; carnitine, aloe vera, protein</td>
</tr>
<tr>
<td>Prozone Fat-Reducing Energy Drink™</td>
<td>184</td>
<td>19</td>
<td>Protein, medium-chain triglycerides, borage oil</td>
</tr>
<tr>
<td>Pripps Amino Energy Sports Drink™</td>
<td>71</td>
<td>17</td>
<td>Protein, branched-chain amino acids, electrolytes</td>
</tr>
<tr>
<td>Pyru Force™</td>
<td>2</td>
<td>0.4</td>
<td>Caffeine, pyruvate, guarana, choline, chromium, inositol, carnitine, vitamin C</td>
</tr>
<tr>
<td>Red Bull™</td>
<td>109</td>
<td>27</td>
<td>Taurine, caffeine, inositol, vitamins</td>
</tr>
<tr>
<td>Red Devil Energy Drink™</td>
<td>80</td>
<td>21</td>
<td>Caffeine, taurine, guarana, ginseng, Ginkgo biloba, vitamins</td>
</tr>
<tr>
<td>SoBe Adrenaline Rush™</td>
<td>135</td>
<td>35</td>
<td>Caffeine, taurine, ribose, carnitine, inositol, ginseng, vitamins</td>
</tr>
<tr>
<td>SoBe Energy™</td>
<td>113</td>
<td>30</td>
<td>Caffeine, guarana, arginine, L-cysteine, yohimbe, vitamin C</td>
</tr>
<tr>
<td>SoBe Power™</td>
<td>107</td>
<td>28</td>
<td>Caffeine, taurine, creatine, proline, vitamin C</td>
</tr>
<tr>
<td>Ultrafit Liquid Endurance™</td>
<td>N.A.</td>
<td>N.A.</td>
<td>Glycerol, carnitine, chromium, vitamin B6</td>
</tr>
<tr>
<td>VAAM™</td>
<td>56</td>
<td>10</td>
<td>17 amino acids</td>
</tr>
<tr>
<td>Venom Energy Drink™</td>
<td>127</td>
<td>28</td>
<td>Caffeine, taurine, mate, bee pollen, guarana, ginseng, protein, vitamins</td>
</tr>
<tr>
<td>180 Energy Drink™</td>
<td>117</td>
<td>32</td>
<td>Guarana, vitamins</td>
</tr>
</tbody>
</table>

*Source: www.excitebluebottle.com  
†Source: www.ultrafit-endurance.com  
‡Source: www.bevnet.com  
§Source: www.getbig.com  
‖Source: www.hansens.com  
©Source: www.prolithic.com  
 insanity: www.gpush.com  
Source: www.maxperformance.com  
†Source: www.nutrinox.com  
‡Source: www.vaam-power.com  
Source: Package label  

Gatorade: 14g/8 oz of CHO: contains sucrose, glucose, fructose
<table>
<thead>
<tr>
<th>INGREDIENT</th>
<th>CLAIMS</th>
<th>FACTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royal jelly/bee pollen</td>
<td>Improved exercise performance</td>
<td>No effect on performance; dangerous for those allergic to bee stings</td>
</tr>
<tr>
<td>Glucose, sucrose, fructose, galactose</td>
<td>Carbohydrate is the preferred fuel source; enhanced performance</td>
<td>Carbohydrate supplements often improve performance. Carbohydrate-rich drinks can be effective for carbohydrate loading up to 2 hours before exercise. If consumed shortly before or during exercise, carbohydrate amounts in energy drinks are usually too much or too little; drinks containing only galactose or fructose can cause digestive problems</td>
</tr>
<tr>
<td>Pyruvate</td>
<td>Enhance aerobic metabolism; delay fatigue; decrease body fat</td>
<td>Amount needed is far in excess of what current products provide; larger quantities cause GI distress</td>
</tr>
<tr>
<td>Branched-chain amino acids (BCAAs)</td>
<td>Decrease brain serotonin; delay fatigue; expedite recovery</td>
<td>No effect on athletic performance when compared to carbohydrate; may cause digestive distress</td>
</tr>
<tr>
<td>Glutamine</td>
<td>Boost immune system; increase glycogen storage</td>
<td>No effect on an athlete’s immune system or on performance</td>
</tr>
<tr>
<td>Arginine</td>
<td>Improve muscle glycogen stores</td>
<td>No benefit; can cause digestive distress</td>
</tr>
<tr>
<td>Creatine</td>
<td>Delay fatigue in high-intensity exercise</td>
<td>Insufficient amount in energy drinks to be effective</td>
</tr>
<tr>
<td>Camitine</td>
<td>Delay fatigue, burn body fat</td>
<td>No effect on athletic performance</td>
</tr>
<tr>
<td>Taurine</td>
<td>Serves as antioxidant; enhances cardiac function</td>
<td>No effect on athletic performance</td>
</tr>
<tr>
<td>Medium-chain triglycerides (MCTs)</td>
<td>Spare glycogen; enhance endurance</td>
<td>No effect on athletic performance; causes digestive distress</td>
</tr>
<tr>
<td>Vitamins and minerals</td>
<td>Essential for normal body functions</td>
<td>Amounts in energy drinks range from trace to megadoses; no effect on athletic performance</td>
</tr>
<tr>
<td>Oxygen dissolved in beverage</td>
<td>Increased aerobic metabolism; decreased lactic acid; improved endurance</td>
<td>No effect on metabolism or athletic performance in typical athletes, who have no deficiency of vitamins</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Stimulates brain function and metabolism; Improves performance</td>
<td>May improve athletic performance; may stimulate urine production and contribute to dehydration if ingested before exercise; may cause nervousness; laxative effect</td>
</tr>
<tr>
<td>Guarana extract; Kola nut extract; Yerba mate extract (“natural” caffeine sources)</td>
<td>Similar to caffeine</td>
<td>Similar to caffeine; often unknown quantities of active ingredients; could lead to anti-doping violation if too much caffeine</td>
</tr>
<tr>
<td>“Fat burners” such as Clujia, hydroxycitrate, ephedra</td>
<td>Stimulate metabolism and brain function; reduce fat</td>
<td>Little or no evidence of athletic performance effect; ephedra can cause cardiovascular dysfunction and death in sensitive individuals</td>
</tr>
<tr>
<td>Kava-kava and St. John’s Wort</td>
<td>Calm the nervous system</td>
<td>No athletic performance effect; kava-kava associated with liver failure</td>
</tr>
<tr>
<td>Amino acids from honey’s saliva</td>
<td>Increase endurance</td>
<td>No evidence of effect on athletic performance in humans</td>
</tr>
</tbody>
</table>
Sport Nutrition for the Runner

- Hydration and Dehydration -
To maintain tight fluid balance, hydration should be at ± 0.2% total body weight
Comfort Zone of impending exhaustion


“The volume of fluid that most athletes ‘choose’ to drink voluntarily during exercise replaces less than one-half of their body fluid losses!”

Dehydration & Exercise

When exercising in the heat:
- may lose up to 4 lbs body wt per hour
- equivalent to 1-2L/hr of water loss
- Thus, losing ~2-3% body wt per hour (assuming 150lb athlete)

NOTE: WATER loss NOT FAT loss

DEHYDRATION IS NOT LIMITED TO EXERCISE IN HOT & HUMID CONDITIONS

- Stop & Go Sports
- Hockey
- Clothing & Equipment
- Lack of Rehydration
## Dehydration: The Signs

<table>
<thead>
<tr>
<th>% BODY WEIGHT LOSS</th>
<th>SIGNS</th>
</tr>
</thead>
</table>
| 2%                 | ↓ TEMP CONTROL  
|                    | ↑ HEART RATE |
| 3%                 | 10% ↓ MUSCLE PERFORMANCE |
| 4-6%               | ↓ MUSCLE STRENGTH  
|                    | ↓ HAND-EYE CO-ORDINATION |
| + 6%               | ↓ BLOOD VOLUME  
|                    | ↑ RESPIRATION RATE  
|                    | NAUSEA & CONFUSION |
| + 10%              | HEAT STROKE & FAINTING  
|                    | EXHAUSTION |

Adapted from Sport Nutrition Advisory Council of Canada
Physiology of Hydration: Importance of Electrolytes

- Electrolytes include sodium ($Na^{2+}$), potassium ($K^+$) and chloride ($Cl^-$).

- All electrolytes carry a charge which makes them vital for proper nerve impulses for proper electrical charge & membrane potential.

- The kidneys are the primary regulator of $Na^{2+}$, $K^+$, and $Cl^-$ in the body. Large sweat rates can alter this mechanism.

**Recommended Intake:**  
$NaCl = \sim 1.5 \text{ g/day}$  
$K^+ = \sim 2-3\text{ g/day}$
Right amount of electrolytes

- Stimulates fluid absorption
- Promotes fluid balance
- Avoids Hyponatremia
- Enhances taste
- Helps body to “hold” onto water
- Decreases cramping

Preventing Dehydration & Sports Performance
Importance of Hydration

- Body fluids consist primarily of water & electrolytes such as salt and smaller amounts of potassium
- **Water & electrolytes** are important to exercise performance:
  1. Maintain blood volume & osmolarity to transport oxygen effectively and regulate blood pressure
  2. Remove wastes and toxins
  3. Proper neural conduction for muscle function
  4. Regulate body temperature by sweating
  5. Important for replenishing energy stores (ie. muscle glycogen) in recovery
  6. Homeostasis of metabolic & enzymatic functions
  7. Shock absorbing & lubricating properties
Dehydration: What Happens During Exercise?

- Exercise
- Muscle Contractions
- Heat Production
- Core Body Temperature
- Sweat Rate
- To decrease core body temp.
- Blood Volume
- Body Fluids
- If not rehydrating
Dehydration:
What Happens with Decreased Blood Volume?

As blood volume decreases so does the ability to dissipate heat from body core.

\[
\text{Blood Volume} = \text{Stroke Volume (SV)}
\]

**DEHYDRATION:**
\[
\text{Cardiac Output (Q)} = \text{Stroke Volume (ml/beat)} \times \text{Heart Rate (beats/min)}
\]

**RESULT:** Decreased muscular endurance & strength -- overall physical performance.
GOALS:

3. Increase fluid intake slowly and practice drinking!!!
   - Don’t attempt new challenges on race/event day!

When training your muscles - train your body to drink!!

- You can calculate your sweat volume lost - Attempt to increase your fluid ingestion by ~ 1 cup until you meet your goals.

- Sip frequently - this may be more comfortable for the athlete!!!

- Like what you are drinking - if you don’t, you won’t drink it!!!
Eat like a Champion, To Become a Champion!
Good Websites and References:

Health and Science Journal Search Engine: www.pubmed.com


American College of Sports Medicine: www.acsm.org/index.asp
Trent Stellingwerff

Academics
- Honors BSc- Cornell University, 2000
- Major: Nutritional Sciences; Minor: Exercise Science
- Undergraduate Research Assistant in Vitamin E Metabolism with Dr. Robert Parker from 1998-2000 at Cornell.
- Red Key Honour Society - Academic/Athletic Society at Cornell
- Currently a PhD Candidate at the University of Guelph, Dept. of Human Biology and Nutritional Sciences under Dr. Lawrence Spriet

Work Experience
- 4+ years with Second Dimension Int. as part-time Gatorade Rep.
- 3rd Year as a TA (Teaching Assistant) at the Health and Performance Centre at the University of Guelph in the Physiotherapy Dept.

Athletics: Track & Field/ Cross-Country
PB’s: 800m- 1:53.03, 1000m- 2:26.93, 1500m- 3:53.78, (Mile ~4:10)
10km X-C- 33:10, 15km- 51:23
- High school OFSAA Silver Medallist in Sr. Boy’s 800m in 1996
- 5-Time High school OFSAA Track and Field Qualifier
- 2-Time All-Ivy League and All-East at Cornell University,
  Earned a total of 7 varsity letters in cross-country and track and field
- 2-Time All-Canadian at Indoor Track and Field at University of Guelph (‘01&’02)
- 2-Time CIS National Silver Medallist (4x800m relay in ‘01&’02)
- Level I and Level II Distance NCCP (National Coaching Certification Program) Certified in Track and Field
- Assistant Distance coach at the University of Guelph
  (University of Guelph men’s program has been the #1 Ranked Cross-Country program in Canada the last 4 years and the women have been at least top-3 for the last 6 consecutive years)