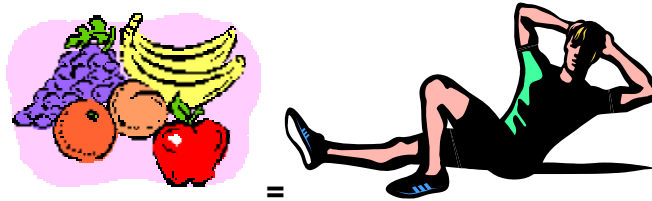


ENERGY FUELING

by

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HOW TO BEST FUEL THE BODY BEFORE, DURING AND AFTER PHYSICAL ACTIVITY?



It is crucial that an active individual meets all his/her daily caloric intake through a nutritious diet. There is no single food or supplement that will enhance “**performance**” but the consumption of a balance meal. Whether training a competitive athlete or those who exercise for health and fitness, it is important to understand the role of the body’s Energy Substrate Nutrients known as:

Carbohydrate (CHO); **Lipids** (FATS), and **Protein**.

Briefly, **CHO** commonly known as “**Sugar**” is the most important fuel for the body. For instance, the central nervous system requires “**carbohydrate**” at all times for proper functioning. In extreme conditions of starvation or improper nourishment, the body will find ways to produce carbohydrates (sugar) from different sources (i.e., breakdown of proteins/ fats) with known detrimental side effects (i.e., formation of Ketone Bodies).

Carbohydrate (**glucose/glycogen**) is the main source of energy both during Anaerobic and Aerobic activity. High intensity activities lasting anywhere

from 10 to 90 seconds will oxidize glucose (Anaerobic glycolysis) for the production of Energy: “**ATP**”. Low to moderate intensity activities of longer duration (> 90 seconds) will also oxidize glucose in addition to fats for energy production (Aerobic glycolysis).

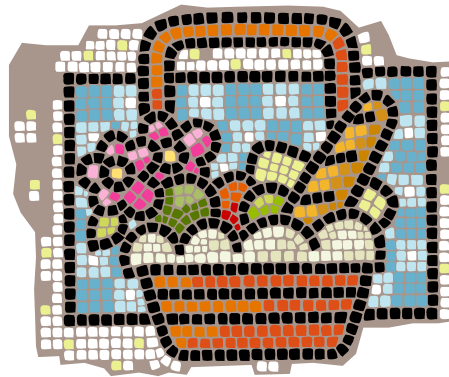
Further, **Lipids** commonly known as **Fats**- are among many other roles an important source of fuel during physical activity as well as to be a key structural component of many cells. Further, most of the body fat in humans is stored in subcutaneous and deep visceral adipose tissue. In addition, a small percentage of body fat is stored in the skeletal muscle cells (approximately 300 grams). At the onset of exercise there will be a shift in the amount of Fat/CHO being oxidized and, hence, its contribution to energy production. The rate of Fat and CHO oxidation will depend on several factors including exercise intensity, duration, and an individual's level of fitness.

Lastly, **Proteins** are made of building blocks known as “**amino acids**”. There are 20 different amino acids in proteins and a few non-protein amino acids. There is only a very **small increase** in protein breakdown during exercise. Thus, the oxidation of amino acids Leucine and Alanine has been shown during moderate exercise.

Now that we understand the role of the body's energy substrate systems – CHO, FAT, and PROTEIN- in relation to physical activity, it is imperative to know “**when**” and “**what**” to consume to best optimize performance and recovery. It is well known that CHOs are the main source of energy for both anaerobic and aerobic exercise. The body needs a minimal amount of circulating blood

“Glucose” present for proper energy production during activity (i.e. $100 \text{ mg}\cdot\text{dl}^{-1}$). In addition, Fat oxidation during activity requires as well a minimal amount of blood glucose present (i.e., $> 65\text{mg}\cdot\text{dl}^{-1}$) before fatigue sets in. Thus, the **“key”** to enhance performance is to know when and what to fuel the body before, during, and after physical activity?

WHAT SHOULD BE CONSUMED PRIOR TO PHYSICAL ACTIVITY?



- **ENDURANCE ACTIVITY:** A medium to high carbohydrate meal (200 to 350 grams) within 3 to 6 hours prior to exercise. Keep in mind that it takes approximately 3 to 4 hours for the body to absorb 100 grams of CHO. However, at 3 hours prior to a training session, CHO intake should be limited to about $1.4\text{g}/\text{lb BW}$ (i.e., Female client = $128 \text{ lbs} \times 1.4\text{g} = 179$ grams of CHO). Plus, at 1 hour or less prior to exercise, CHO intake should be limited to 50 grams and/or $0.5 \text{ g}/\text{lb BW}$ (i.e., female client = $128 \text{ lbs} \times 0.5 = 64$ grams of CHO).

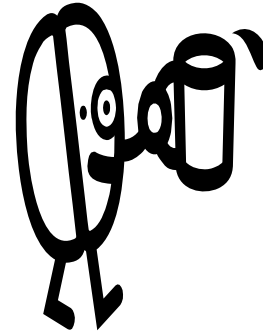
CHO SNACKS			
FOOD	SERVING	CALORIES	CHO g
Bagel	½	85	15
Bread	1	105	15
Cereal	½	60	10
Graham crackers	2 squares	75	15
Oatmeal	½ cup	80	15
Rice(brown)	½ cup	115	25
Tortilla	1	85	15
Apple	1 md	80	20
Banana	1	105	25
Dates-dried	5	115	30
Orange	1	65	15
Raisins	1/3 cup	150	40
Potato (baked/plain)	1 large	220	50
Sweet potato	1 large	120	30

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- **RESISTANCE TRAINING:** A combination of a CHO and Protein snack (i.e., 50 grams of CHO plus a 14 grams of protein) approximately 1 ½ - 2 hours before the training session (i.e., 2 slices whole-grain toast and 2 tbsp peanut butter; 1 cup yogurt and ¼ cup raisins ; whole-wheat pita and

½ cup of canned tuna; whole grain pita with hummus; energy bar-Power bar- and 8-ounce sports drink – Gatorade-.).

WHAT SHOULD BE CONSUMED DURING PHYSICAL ACTIVITY?



- **ENDURANCE ACTIVITY:** For activities lasting more than 90 minutes it is suggested that CHO be consumed at a rate of 30 to 60 grams per hour throughout the activity (i.e., 1 power bar/hr). Also, CHO can be consumed via “**Sports Drinks**” at a rate of 600- 1,200 milliliters (20 to 40 ounces) per hour.
- **RESISTANCE TRAINING:** To date, the exact amount of CHO intake during resistance training has not been established. As with Endurance activity, it is probably safe to suggest that CHO intake in the form of “sports drinks” at a rate of 20 to 40 ounces/hr could be beneficial for training sessions lasting longer than 90 minutes.

HOW MUCH FLUID SHOULD BE INGESTED BEFORE, DURING, AND AFTER PHYSICAL ACTIVITY?

- **BEFORE:** It is important to maintain one's daily fluid needs by ingesting approximately 10 – 12 cups or 80 – 96 ounces of liquids throughout the day. Prior to physical activity (i.e., 2 hours prior) it is recommended to drink at least 2 cups- ice cold- (16 ounces) of water.
- **DURING:** It is imperative to stay hydrated throughout physical activity (specially if performed outdoors in warm temperatures). The recommendations are to drink 5- 10 ounces of fluid, every 15-20 minutes. For activities lasting under 60 minutes of duration, ice cold water should be sufficient. Thus, activities longer than 60 minutes of duration (i.e., >90 minutes) should include a combination of water plus an electrolyte drink (i.e., Gatorade).
- **AFTER:** A quick recovery tip is to drink 2 cups of fluid (16 ounces) for every 1 pound of body weight lost during physical activity.

****Note that all drinks and beverages ingested should be ice cold in temperature, palatable and non-carbonated.**

WHAT SHOULD BE CONSUMED POST PHYSICAL ACTIVITY?

- **ENDURANCE AND RESISTANCE TRAINING ACTIVITY:** A combination of CHO and Protein plus a drink should be consumed within the first 2 hours post activity. For instance, 50 grams of CHO and 10-15 grams of protein with fluid (i.e., sports drink + energy bar – power bar; whole grain pita with hummus + apple juice; low fat yogurt with walnuts and dried apricots).



HOW TO SELECT ENERGY BARS AND ELECTROLYTE DRINKS?

- **Energy Bars:** a) total calories (200 to 300 kcal per bar); b) CHO% of total calories (50 to 60%); c) Fat % of total calories (20 to 25%); d) Protein % of total calories (15 to 20%). Avoid bars with palm kernel oil or partially-hydrogenated fat (saturated) in the first 5 ingredients on the label. The protein in the bar should come from a quality source such as casein, whey, soy or egg. All energy bars are best tolerated during exercise if ingested with water. Suggested bars: Clif Bar and Power Bar.
- **Electrolyte Drinks:** a) CHO concentration (4 to 8 % or 9 to 19 grams of CHO per 8 ounces); b) Sodium (5%- 7% concentration or 110 – 165 mg per 8 ounces). Suggested drinks: Gatorade and Power Aid.
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THE BODY IN BALANCE

The key for proper body functioning and/or performance is to maintain proper nutritional balance throughout the day. There is no “**magic**” pill that will enhance performance but the consumption of a well-balanced diet. According to several National organizations including the AHA; NIH; ADA; CI; the recommended dietary ranges for most Americans are:

- CHO: 45% to 65% of total calories (minimum of 130 grams/day).
- Fat: 20% to 35% of total calories.
- Protein: 10 to 35% of total calories.

For more in depth food and nutrition guide, please, refer to

“**WWW.MyPyramid.gov**”(Food guidance system, April/2005).

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