Nutrient Timing: The New Frontier in Fitness Performance

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Introduction

Exercise enthusiasts in aquatic exercise and other modes of exercise regularly seek to improve their strength, stamina, muscle power and body composition through consistent exercise and proper nutrition. It has shown that proper nutritional intake and a regular exercise regimen will bolster the body in achieving optimal physiological function (Volek et al., 2006). The science behind nutrient timing suggests that knowing what to eat and when to eat is a critical key to successfully achieving these health, fitness and performance goals. This article will synthesize the current understanding of how nutrient timing helps to repair tissue damage, restore physiological function, replenish glycogen stores, and promote muscle growth.

What Is Nutrient Timing?

Nutrient timing is the application of knowing when to eat and what to eat before, during and after exercise. It is designed to help athletes, recreational competitors, and exercise enthusiasts achieve their most advantageous exercise performance and recovery. There are three distinct phases in the nutrient timing system that are based on muscle, its nutritional requirements, and its recovery demands for best strength and endurance results. But first, a basic review of the hormones of exercise is warranted.

The Hormonal Responses To Exercise

Within the body are numerous catabolic (breaking down) and anabolic (building up) hormones that are stimulated by exercise. Catabolic hormones aid in the disassembly of nutrients for energy production or cells needs. The main catabolic hormones of exercise are epinephrine, norepinephrine, cortisol and glucagon. Anabolic hormones support muscle hypertrophy (growth), tissue repair, inflammation control, and facilitate the regulation of carbohydrate, fat and protein metabolism. The anabolic hormones of interest during exercise are insulin, testosterone, IGF-I and growth hormone.

The Catabolic Hormones

During aerobic exercise, levels of epinephrine and norepinephrine are elevated to prepare (or mobilize) the cells for the breakdown of glycogen (converting it to glucose for fuel) in the liver and muscle. These hormones also increase the heart rate, blood pressure, heart contractility, blood redistribution to muscle, and respiration rate to meet the physiological needs of the continuous dynamic exercise.

Cortisol is largely responsible for the breakdown of carbohydrate and fat for energy during exercise. It is a very important catabolic hormone that is activated when low blood glucose levels are present, such as during exhaustive exercise. **If the body is low in glucose and glycogen, cortisol will send amino acids to the liver to make new glucose, referred to as gluconeogeneses. Thus, in exercise, when carbohydrate sources are dwindling, cortisol takes the building blocks of proteins (amino acids) and uses them for new glucose synthesis.** Glucagon stimulates fat breakdown and also helps to raise blood glucose levels

by increasing the release of glucose and the rate of gluconeogeneses (Ivy & Portman, 2004).

The Anabolic Hormones

One widely known anabolic hormone is insulin. Insulin sensitivity is increased during aerobic and resistance exercise, which literally means there is an enhanced glucose uptake for muscle contraction. It also accelerates the transport of amino acids into muscle and stimulates protein synthesis in muscles (Levenhagen et al., 2001). However, during sustained aerobic exercise insulin levels in the blood decrease slightly because epinephrine and norepinephrine inhibit the release of insulin from the pancreas.

Another important anabolic hormone is testosterone. Testosterone is a powerful hormone for protein synthesis and muscle hypertrophy. The amount of testosterone within the body increases with exercise (Ivy & Portman, 2004). Growth hormone is an anabolic hormone that promotes bone and cartilage growth. It is also responsible for stimulating IGF-I, a hormone responsible for the development of muscle cells from myoblasts (immature muscle cells) into myotubes (growing muscles cells) and then into mature muscle fibers. High levels of IGF-I are needed in order to promote muscle hypertrophy. Growth hormone also increases protein synthesis (Volek, 2004).

The Three Nutrient Timing Phases

The nutrient timing system is split into three distinct phases:

1) Energy Phase ***(just before and during workout***)
2) Anabolic Phase (***post 45 minutes of workout***)
3) Growth Phase (r**emainder of the day**)

The Energy Phase

Muscle glycogen is the primary fuel (followed by fat) used by the body during exercise. Low muscle glycogen stores result in muscle fatigue and the body's inability to complete high intensity exercise (Levenhagen et al., 2001). The depletion of muscle glycogen is also a major contributing factor in acute muscle weakness and reduced force production (Haff et al., 2000). **Both aerobic and anaerobic exercise decrease glycogen stores, so the need for carbohydrates is high for all types of exercise during this energy phase.**

Several hormonal and physiological responses occur during the energy phase. **Cortisol levels are increasing, insulin levels are slightly decreasing, and muscle glycogen levels are becoming depleted, making the energy phase catabolic (Ivy & Portman, 2004). Therefore, the goals with the energy phase are to increase nutrient (primarily carbohydrate and some protein) delivery to muscles, spare glycogen and protein loss, limit immune system suppression, minimize muscle damage and prepare nutritionally for a faster recovery (Ivy & Portman, 2004).**

Prior to aerobic exercise, protein intake with carbohydrate supplementation has been shown to stimulate protein synthesis post-exercise (Volek et al., 2006). The combined intake of carbohydrate and protein (pre-exercise) also aids in the rate of muscle recovery after exercise (Ivy & Portman,

2004).

Carbohydrate supplementation prior to resistance training can increase the body's capacity to perform more sets, repetitions and prolong a resistance training workout (Haff et al., 2000). It will help to maintain blood glucose levels, sustain immune function, and aid in the suppressing of cortisol (Ivy & Portman, 2004).

The Anabolic Phase: The 45-Minute Optimal Window

The anabolic phase is a critical phase occurring within 45 minutes post-exercise. It is during this time that muscle cells are particularly sensitive to insulin, making it necessary to ingest the proper nutrients in order to make gains in muscle endurance and strength. **If the proper nutrients are ingested 2 - 4 hours post-exercise they will not have the same effect.** It is also during this time in which the anabolic hormones begin working to repair the muscle and decrease its inflammation. **Immediate ingestion of carbohydrate is important because insulin sensitivity causes the muscle cell membranes to be more permeable to glucose within 45 minutes post-exercise.** This results in faster rates of glycogen storage and provides the body with enough glucose to initiate the recovery process (Burke et al., 2003). Muscle glycogen stores are replenished the fastest within the first hour after exercise. **Consuming carbohydrate within an hour after exercise also helps to increase protein synthesis (Gibala, 2000).**

The Growth Phase

The growth phase consists of the 18 - 20 hours post-exercise when muscle repair, growth and strength occur. According to authors Ivy and Portman, the goals of this phase are to maintain insulin sensitivity in order to continue to replenish glycogen stores and to maintain the anabolic state. **Consuming a protein and carbohydrate meal within 1 - 3 hours after resistance training has a positive stimulating effect on protein synthesis (Volek, 2004).**

Carbohydrate meals with moderate to high glycemic indexes are more favorable to enhance post-exercise fueling. Higher levels of glycogen storage (post-exercise) are found in individuals who have eaten high glycemic foods when compared to those that have eaten low glycemic foods (Burke et al., 2003).

Nutrient Timing Supplement Guidelines:

Putting it Together for Yourself and Your Clients

Aquatic instructors expend a lot of energy in teaching and motivating students during multi-level fitness classes. Clearly, nutrient timing may be a direction the aquatic profession may choose to pursue to determine if it provides more energy and faster recovery from a challenging teaching load. As well, some students and clients may seek similar results. From the existing research, here are some recommended guidelines of nutrient timing.

Energy Phase *(just before and during workout)*

- **During the energy phase a drink consisting of high-glycemic carbohydrate and protein should be consumed.**

- **This drink should contain a 4:1 ratio of carbohydrate to protein and should include approximately 6 grams of protein and 24 grams of carbohydrate.**

- **Additional drink composition substances should include leucine (for protein synthesis), Vitamin C and E (because they reduce free-radical levels-which are a contributing cause to muscle damage), and sodium, potassium and magnesium (which are important electrolytes lost in sweat).**

- **Accelerade** (Powder form) would be a good choice here. It Provides the 4:1 ratio of carbs to protein. It contains 100% of DV of Vitamin C & E. It also provides 190 mg of sodium, 65 mg of potassium, and 30% of DV of magnesium. During exercise, as a general rule you should consume approximately 20-32 oz of fluid for every hour of exercise. This should consist of ingesting several ounces of Accelerade every 10-15 minutes throughout activity. However, there is large variability between individuals as to their tolerance for fluid intake ie, GI distress).
  Accelerade is available in a 'ready-to-drink' (RTD) version but, to the best of my knowledge, only online: www.accelerade.com/products/
  [This is my suggestion based on www.accelerade.com, not the authors']

Anabolic Phase *(post 45 minutes of workout)*

- **During the anabolic phase a supplement made up of high-glycemic carbohydrate and protein should be consumed. This should be a 3:1 ratio of carbohydrate to protein and should contain approximately 15 g of protein and 45 grams of carbohydrate. Other important drink substances include leucine (for protein synthesis), glutamine (for immune system function), and antioxidant Vitamins C and E.**

- **Endurox R4** (powder form) would be a good choice for this phase. It contains a little more than double that of Accelerade. The main differences being that Endurox contains much higher amounts of Vitamin C and E, and L-Glutamine (~420 mg/serving).
  [This is my suggestion, not the authors'].

Growth Phase *(remainder of the day)*

- There are two segments of the growth phase. The first is a rapid segment of muscle repair and growth that lasts for up to 4 hours.

- The second segment is the remainder of the day where proper nutrition guidelines are being met (complex carbohydrates, less saturated fats--substituting with more monounsatureated and polyunsaturated fats, and healthy protein sources such as chicken, seafood, eggs, nuts, lean beef and beans).

- During the rapid growth phase a drink filled with high-glycemic carbohydrates and protein may be consumed. In this phase the ratio of carbohydrates to protein should be 1:5 with 4 grams of carbohydrate to 20 grams of protein.

- Jenna Bell-Wilson, RD (Board Certified Specialist in Sports Dietetics) also encourages some protein/carbohydrate snacks during this phase such as:
  a) Energy bar and sports drink
  b) 2 slices whole-grain toast with 2 tbs peanut butter
  c) 1 cup cooked oatmeal with 1/4 cup raisins
  d) 1/2 cup sunflower seeds and 1 glass orange juice
  e) 1/2 cup of nuts and an apple

- The 'Word' on Nutrient Timing
  It is not the purpose of this article to 'endorse' any nutrient products currently available on the market. However, the information and discussion in this article better prepares the aquatic fitness professional to guide and educate students about the metabolic and nutrient needs of exercising muscles.

- In the areas of nutrition and exercise physiology, nutrient timing is 'buzzing' with scientific interest. Ingestion of appropriate amounts of carbohydrate and protein at the right times will enhance glycogen synthesis, replenish glycogen stores, decrease muscle inflammation, increase protein synthesis, maintain continued muscle cell insulin sensitivity, enhance muscle development, encourage faster muscle recovery and boost energy levels…that says it all.

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