Fat Adapted Fueling

Enhance Your Body's Ability to Burn Fat

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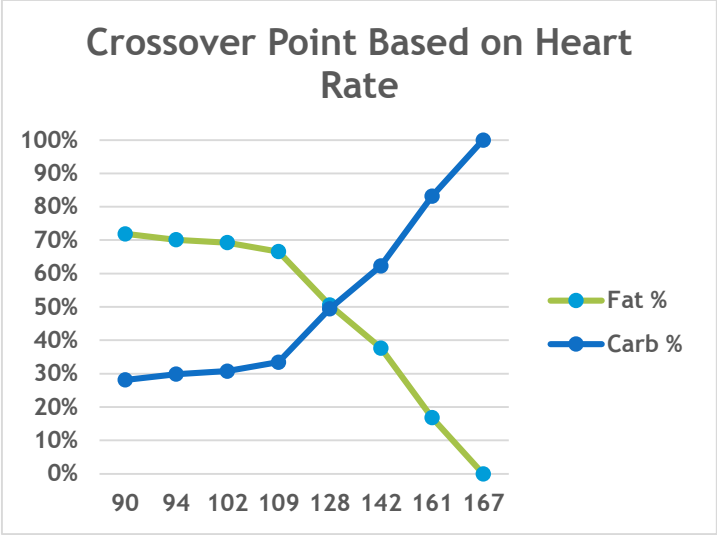
Introduction

You've likely read my posts about being fat-adapted or metabolically efficient, but may not understand what this means. What follows is a brief introduction to the concept with some information about why you may want to consider becoming more efficient at burning fat.

This is a topic that I have become very passionate about. For more than a decade I have been competing in endurance sports, I have always sought a magical carbohydrate formula that would fuel my performance without gastrointestinal distress (gas, bloating, diarrhea…). If you are familiar with endurance sports, you know that I am not alone. Gastrointestinal (GI) distress is a common topic for discussion among athletes. The fact is that there is no magical carbohydrate. Every form of carbohydrate has issues when eaten in excess. This makes it challenging to apply the traditional carbohydrate-based sports nutrition approach in an endurance event, such as a marathon, ultra marathon or iron-distance triathlon. So what is the alternative? I had a great opportunity to explore and research alternatives, as I chose this topic for my thesis research project.

Background

Our bodies have a few different ways to generate energy or ATP via the aerobic (with oxygen) or anaerobic (without oxygen) energy systems. Glucose is the primary energy source when the body is in an anaerobic state, typically during higher intensity exercise. The aerobic system produces ATP via the Krebs cycle and can use glucose, fat and some protein. Protein is not an efficient source so most of the energy comes from glucose converted from carbohydrates and free fatty acids from the diet and stored triglycerides. During exercise, intensity mainly determines what fuel source the body can use. The crossover concept, which has been around since the 1930s, describes the relationship between intensity and energy substrate. The chart below shows the result from a personal test analyzing the use of fat versus carbohydrate at different intensities, based on heart rate. As you can see, the subject burns more fat at a lower intensity. The crossover point is the point at which carbohydrate becomes the primary fuel source.



As I researched more on the energy systems and the crossover concept, I considered the overall concept of endurance training. The goal of aerobic training is to keep the body in a fat burning state during exercise. Meanwhile, traditional sports nutrition tells us to constantly consume carbohydrates while we exercise. I questioned why we are training our body to burn fat, while feeding it carbohydrates. This led me to consider how we can help the body to more efficiently burn fat with dietary changes, resulting in less need to eat carbohydrates during exercising or at rest. As the need decreases for carbohydrate digestion during exercise, the risk for GI distress also decreases.

Challenges with Digestion Leading to GI Distress

If you are an athlete and follow traditional sports nutrition philosophies, you are likely consuming 50-90 grams of carbohydrate per hour before, during and after training and racing. The challenge with this approach is that during exercise, digestion is compromised. Our sympathetic nervous system, which is our fight or flight system, dominates. This is a good thing, as this allows us to run faster and jump higher; however, the parasympathetic nervous system, which helps us to rest and digest, is suppressed. This reduces blood flow to the GI tract, decreases intestinal motility and reduces gastric emptying, which means that food is digested much more slowly. Digestion is further compromised with heat and dehydration. If an athlete continues to eat carbohydrates that are not getting fully digested, fermentation in the gut can occur, which leads to gas and bloating. In addition, intestinal secretions increase with the pounding effect of running, which can lead to diarrhea.

So how can an athlete fuel exercise when digestion is compromised? He or she can train the body to become more efficient at using its own energy stores.

Benefits of Fat as Fuel Versus Carbohydrate

Our body has two main sources of stored energy: glycogen (glucose/carbohydrate) and fat. Even the leanest athlete is carrying around hours of energy in body fat. Let's compare glycogen (carbohydrate) stores to fat stores on a lean, 120 pound female athlete, with 15% body fat (see table below). Assuming she's fully glycogen loaded, she has less than 2 hours of

energy available in her muscle and liver glycogen stores. Alternatively, she has more than 66 hours of energy available in her body fat. Most people would consider this athlete to be lean, but she has more than enough body fat to fuel a marathon or an Ironman triathlon.

	Mass (kilograms)	Energy Available (kcalories)	Exercise Time (minutes)
Liver Glycogen	.10	400	21
Muscle Glycogen	.40	1,600	84
Fat	8.18	76,000	4,000

Almost unlimited availability is an obvious advantage to using fat for fuel. In addition to its abundance in the body, burning fat has other advantages that apply to elite athletes, recreational athletes, weekend warriors and people who hate to exercise.

- Burning fat minimizes blood sugar fluctuations and improves brain function. This leads to steady energy during training and throughout the day. This means less of the dreaded afternoon crash or sugar cravings. For an athlete, this also means less risk of bonking.
- Research has shown that a reduced intake of refined carbohydrates leads to lower levels of inflammation. Inflammation has been shown to contribute to major illnesses, such as obesity, diabetes and cardiovascular disease. In addition, athletes naturally induce considerable inflammation from endurance exercise so dietary changes that combat this will help improve recovery and minimize the risk of injury.
- High carbohydrate diets contribute to weight gain and insulin resistance, which is a precursor to diabetes. When we eat carbohydrates, insulin is secreted to allow glucose to enter the cells for energy generation. Because of this, insulin is critical to our survival; however, insulin is a fat storage hormone and too much insulin leads to excess body fat, particularly in the abdomen. How many endurance athletes do you know that train for many hours each week, but are still struggling to lose those last 5 to 10 pounds?
- Carbohydrates, particularly fructose found in high fructose corn syrup and many sports nutrition products, are processed in the liver. This creates extra work for the liver, which is already one of the hardest working organs in the body. Once converted to triglycerides, carbohydrates are easily stored in fat cells. Carbohydrates have only two functions in the body: convert to energy or store as fat.
- Carbohydrates increase free radical damage. Free radicals start a chain reaction of damage to our cells, particularly our mitochondria, which generate most of our aerobic energy. In addition, when carbohydrates meet protein in our bloodstream, they create AGEs or advanced glycation end products. AGEs change the fibers in collagen, which can lead to skin wrinkling and joint degradation. AGEs also increase the risk of cardiovascular disease.
- Excessive sugar intake reduces immune function. High sugar intake, along with lower fiber intake, disrupts the balance of healthy and harmful bacteria in our GI tract. Additionally, sugar and vitamin C use the same receptors to enter our cells, the GLUT-

1 receptors. Because blood glucose levels must be monitored closely, glucose will always gain entry before vitamin C.

- Burning stored fat spares stored glycogen. It's true that some glucose is needed for fat burning. Having glycogen available for a longer period of time reduces the need for taking in carbohydrates during exercise. Some like to say that fat burns in a carbohydrate flame, but think of carbohydrates as kindling and fat as the log on a fire. You need to constantly replenish kindling but one log burns much longer.

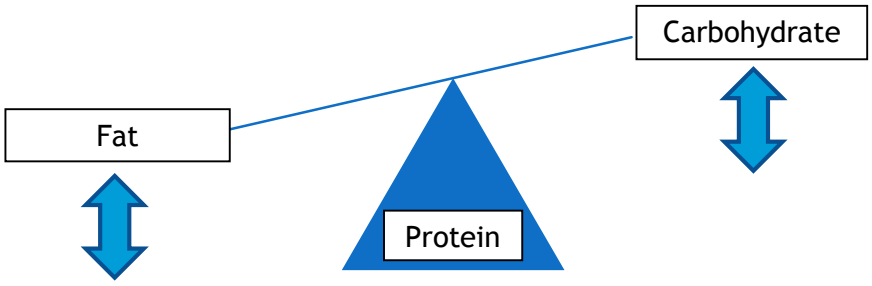
Fat Adapted Fueling Nutrition

As I mentioned previously, aerobic training does help the body to become more efficient at burning fat, but most of the adaptation happens within the muscles. The mitochondria in the muscles become more efficient at burning fat stored within the muscles (intramuscular triglycerides). This makes the body about 25% more efficient at burning fat. Most of the fat is stored in adipose tissue. This fat must be mobilized and transported into muscle cells for energy conversion. When a person constantly fuels the body with carbohydrates, the body is less able to teach the body to burn stored fat. Contrary to what we have been told since the late 1970s, we need to eat fat to burn fat. The body is very smart and, when given more fat in the daily diet, it will make adjustments. The body will produce more of the enzymes that regulate the break down triglycerides stored in adipose tissue and carrier proteins that transport free fatty acids to the mitochondria inside the muscle cells.

I am not advocating little or no carbohydrates in the diet. Carbohydrates are an essential energy source to the body. We simply need to think about the type and amount of carbohydrates we are eating. Many people only view bread, pasta and grains as carbohydrates, but vegetables and fruits are also carbohydrates. Vegetables and fruits provide high levels of vitamins, minerals, antioxidants, fiber and should become the main source of carbohydrate fuel. Carbohydrates that do not have all the beneficial nutrients and fiber, such as sweets, breads, pasta and some refined grains are what I like to call "carbage." They spike insulin, put the body into a fat storage mode and leave you hungry in an hour or two.

Along with healthy carbohydrates and a moderate protein intake, healthy fats should make up the bulk of the diet. Some of my favorite healthy fats are coconut oil, avocados, olive oil, wild-caught fish and pasture butter.

Please keep in mind that the optimal macronutrient ratios between fat, carbohydrate and protein will differ for everyone. In addition, the optimal ratio will change from day to day, depending on health status, exercise volume and intensity. In a healthy person, the protein level typically remains the same, but the fat and carbohydrate intake should vary. Like a seesaw, the fat and carbohydrate can move up and down, depending on daily needs, but the protein intake remains fairly constant.



If you would like to see what I eat in the week leading up to a race, please see my taper nutrition blog post.

Fat Adapted Fueling is a useful tool for everyone, whether you exercise or not. Anyone can benefit from adopting changes in the diet that improve the ability to burn fat. Our country is plagued with obesity, diabetes and cardiovascular disease. Removing refined carbohydrates and adding healthy fats to the diet can help with all of these conditions.

I have personally seen the benefits of becoming fat-adapted using the Fat Adapted Fueling approach. I have had personal records in races of all distances from sprint to iron distance triathlons. I've experienced no bonk during or after the races and had no gas, bloating or other GI issues. There have also been positive benefits outside of training. My energy is much more consistent throughout the day and my body composition has improved. I have also seen amazing results with clients that I consult, such as weight loss and reduced dependence on carbohydrate sports nutrition products.

Do you want to lose some of your extra body fat? Do you want to feel more energetic the longer you work out? Do you want to minimize GI distress during endurance races? Do you want to have stable energy throughout the day? Even if you are a high carbohydrate burner today, you can make nutrition and exercise changes that will start to improve your ability to burn fat. You will become more efficient at fat burning the longer you use the Fat Adapted Fueling approach, but you can feel improvements in just a few weeks. Fat Adapted Fueling can help you achieve your athletic performance goals or help you simply lose a few pounds of body fat. Please contact us for more information. We can help by creating a specific plan that is as unique as you are.

Sources:

Achten, Juul and Asker Jeukendrup. Optimizing Fat Oxidation Through Diet and Exercise. April 2004. Web. 30 April 2013. <www.sciencedirect.com/science/article/pii/S0899900704000966>.

Ashrafi, Kaveh. Obesity and the Regulation of Fat Metabolism. 2007. Worm Book. Web. 5 May 2013.

Bergman, BC and GA Brooks. "Respiratory Gas-Exchange Ratios During Graded Exercise in Fed and Fasted Trained and Untrained Men." Study. University of CA-Berkeley. Berkeley, 2004. Print.

Bergman, BC and GE Butterfield. "Muscle Net Glucose Uptake and Glucose Kinetics After Endurance Traning in Men." Study. University of CA-Berkeley. Berkeley, 2002. Print.

Dimeo, FC, J Peters and H Guderian. "Abdominal Pain in Long Distance Runners: Case Report and Analysis of the Literature." British Journal of Sports Medicine. 29 August 2003. Print.

Erasmus, Udo. "Udo Erasmus Danish Athlete Study." 2001. Udoerasmus.com. Web. 30 April 2013.

Glace, B, C Murphy and M McHugh. "Food and Fluid Intake and Disturbances in Gastrointestinal and Mental Function During an Ultramarathon." International Journal Of Sport Nutrition And Exercise Metabolism (2002): 414-27. Print.

Greenfield, Ben. "The Basics of Metabolic Efficiency with Ben Greenfield." The Garden Variety Triathlete. Jon Smith. 28 December 2012. Web. May 5 2013.

Greenfield, Ben. "The Low Carbohydrate Diet for Triathletes." January 2013. Ben Greenfield Fitness. Web. 20 February 2013.

Greenfield, Ben, perf. "The Dangers of Extreme Carb Restriction." The Livin' La Vida Low-Carb Show with Jimmy Moore. Jimmy Moore. 20 May 2013. Web. 24 May 2013.

Howlett, RA and ML, et al. Parolin. "Regulation of Skeletal Muscle Glycogen Phosphorylase and PDH at Varying Exercise Power Outputs." American Journal Of Physiology. 275 (1998): R418-R425. Print.

Hyman, Mark. The Blood Sugar Solution. New York: Little, Brown and Company, 2012. Print.

Jeukendrup, Asker and Michael Gleeson. Sport Nutrition. Vol. II. Champaign: Human Kinetics, 2010. Print.

Kaleta, Christoph, et al. "In Silico Evidence for Gluconeogenesis from Fatty Acids in Humans." PLOS Computational Biology. 2011. Web. 15 March 2013

Kauslendratripathi. "Principles of Biochemistry." 29 October 2011. Wiki Books. Web. 5 May 2013.

Kim, JH, J Kim and Park. Y. "US National Library of Medicine National Institutes of Health." 11 July 2012. NCBI. Web. 30 April 2013 <www.ncbi.nlm.gov/pubmed/22782371>.

MacLaren, Don and James Morton. Biochemistry for Sport and Exercise Metabolism. West Sussex: John Wiley & Sons, Ltd. , 2012. Print.

Maffetone, Phil. The Big Book of Endurance Training and Racing. New York: Skyhorse Publishing, 2010. Print.

McArdle, William, Frank Katch and Victor Katch. Sports & Exercise Nutrition. Santa Barbara: Lippincott Williams & Wilkins, 2005. Print.

Murray, R, et al. "The Effects of Glucose, Fructose, and Sucrose Ingestion During Exercise." Medicine and Science in Sports and Exercise. Barrington, 1989. Web. 20 February 2013

Oktedelan, O, et al. "Changes in Gastrointestinal Mucosa after Long-Distance Running." Study. Ulleval University Hospital . Oslo: Scandinavian Journal Of Gastroenterology, 1992. Web. 15 February 2013.

Peters, SJ and SJ, et al. St. Amand. "Human Skeletal Muscle Pyruvate Dehydrogenase Kinase Activity Increases After a Low-Carbohydrate Diet." American Journal of Physiology 275 (1998): E980-E986. Print.

Peveler, WW, PA Bishop and EJ Whitehorn. "Effects of Ribose as an Ergogenic Aid." 20 August 2006. Web. 5 May 2013.

Pirnay, Jack. "Fate of Exogenous Glucose During Exercise of Different Intensities in Humans." Journal Of Applied Physiology 53 (1982): 1620-1624. Print.

Prado de Oliveira, Erick and Roberto Carlos Burini. "Food-Dependent, Exercise-Induced Gastrointestinal Distress." Journal of the International Society of Sports Nutrition September 2011: 1-7. Print.

Salah, Jumana. "Regulation of Fatty Acid Metabolism." August 1999. Science Direct. Web. 30 April 2013.

Seebohar, Bob. Metabolic Efficiency Training. Bob Seebohar, 2009. Print.

Simms, Stacy. "You're Not Bonking. You're Dehydrated!" 6 November 2012. Osmo Nutrition. Web. 10 February 2013.

Soares, F., Matoso, R, et. al. "Gluten-Free Diet Reduces Adiposity, Inflammation and Insulin Resistance Associated with the Induction of PPAR-Alpha and PPAR-Gamma Expression." 18 December 2012. The Journal of Nutritional Biochemistry. Web. 21 May 2013.

Stuempfle, KJ, Hoffman MD and T Hew-Butler. "Association Of Gastrointestinal Distress in Ultramarathoners with Race Diet." Internation Journal Of Sports Nutrition And Exercise Metabolism (2013): 103-109. Print.

Tortora, Gerard and Bryan Derrickson. Principles of Anatomy and Physiology. Vol. 12. John Wiley & Sons, Inc., 2009. Print.

Volek, Jeff and Stephen Phinney. The Art and Science of Low Carbohydrate Performance. United States: Beyond Obesity LLC, 2012. Print.

Volek, Jeff. "Generation UCAN - A Technological Breakthrough in Sports Nutrition Innovation." n.d. Generation UCAN. Web. 30 March 2013.

Watt, MJ, et al. "Intramuscular Triaglycerol, Glycogen, and Acetyl Group Metabolism During 4h Moderate Exercise In Men." Journal of Physiology (2002): 969-978. Print.

Gatorade Sports Science Institute Article Fat Metabolism During Exercise New Concepts http://www.gssiweb.org/Article/sse-59-fat-metabolism-during-exercise-new-concepts