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Serious or Competitive Athlete Part 1—Energy Production

This month's newsletter is focused on energy production within the cell and is primarily aimed at the serious or competitive athlete. However, this information is also critical for anyone who has an exercise program. So much has been written in the literature about the use of high-glycemic carbohydrates as the key for those competitive athletes. I am going to present cutting-edge information in regards to the best way to nourish your body to optimize performance and recovery. Even though there are not many clinical trials that have used low-glycemic meals in athletes, the evidence I present is very compelling. This information is critical for any serious athlete or athletic team.

Energy Production

The body has three systems that are available to the muscle cell for the production of energy or ATP. ATP is needed for muscle contraction and subsequently athletic performance. Therefore, understanding each of these systems and their purpose is critical for optimal athletic performance. There is one aerobic system (which means it requires oxygen) and two anaerobic systems (which do not require oxygen). We will look at each system and where it is needed and obviously its potential consequences on the athletic performance.

Aerobic System

Aerobic metabolism is also referred to as cellular respiration because it requires oxygen to produce ATP. This is a very efficient source of energy although it does not create energy as fast as either anaerobic system. Aerobic metabolism is used for exercise intensities that can be sustained for a long period of time. Examples would be a dancer who is dancing 6 to 8 hours a day or a marathon runner.

During cellular respiration, the mitochondria or furnace of the cell produces ATP by using oxygen and carbohydrates, fats, or proteins. Now the most useable fuel is glucose and this is one of the main reasons why having a constant flow of glucose from the blood stream is critical. When the body needs to break down fats and protein for energy, it is much less efficient and slower. In athletic performance this is not a good thing. Learning to control blood sugars and insulin levels is critical in providing a steady supply of glucose for aerobic metabolism. It also allows the muscle cell to have less dependence on the anaerobic system, which you will learn has a byproduct of lactic acid.

If glucose is not available, the body will break down glycogen stores in the muscle and liver to provide the glucose the cell desires. However, there is very little glycogen stores

available—approximately 525 grams in muscle and another 100 grams in the liver. The body will then break down fat, which is the most concentrated source of fuel. Now if you are trying to lose weight, prolonged medium intensity workouts are best. However; if your goal is athletic performance, supplying a continual flow of glucose to the cell would best option. The final source of energy would be proteins. Since this means the breakdown of muscle cells, this is obviously not desirable.

Anaerobic Systems

Creatine Phosphate System

Creatine phosphate is a high-energy phosphate that supplies energy for the regeneration of ATP. This is an anaerobic system, which means it does not require oxygen. It is utilized by the muscle for high-intensity activity like running a 100 meter dash. It is very efficient and very effective; however, the problem is the fact that there is only enough stored creatine phosphate in the muscle to sustain 8 to 12 seconds of high-intense activity.

Glycolysis

The second anaerobic system is glycolysis. Glycolysis produces ATP by the breakdown of glycogen. Now this is not as quick and efficient the creatine phosphate system but it is quicker than the aerobic system. The major problem with this system is the fact that its byproduct is lactic acid. If lactic acid gets too high in the muscle cell, it will lead to fatigue and significantly affect athletic performance. Now there are times that you need this system during athletic performance; however, it is obvious that you would want to keep this method of energy production at a minimum.

Hormonal Aspects of Energy Production

Catabolic Hormones

As has been mentioned earlier, the muscle cell prefers glucose as its fuel source. However, during aggressive or prolonged exercise glucose levels will fall and secondary fuel sources are necessary. As exercise intensity or duration increase there is a release of the so-called catabolic hormones like cortisol, epinephrine, and norepinephrine. These hormones will facilitate the breakdown of fats, proteins, and glycogen stores to provide the secondary sources of fuel. Epinephrine and norepinephrine primarily enhance the breakdown of glycogen stores in the muscle and liver. Glycogen offers the quickest source of fuel as noted above and can provide glucose for the aerobic system or in the case of glycolysis, fuel for the anaerobic system. Cortisol primarily enhances the breakdown of fat and proteins for energy. Fat is the least accessible fuel, since it needs to be broken down from fat stores and transported to the cell. Fat also requires carbohydrates or glucose to break it down in order to provide fuel for the cell. Fat is really only a good source of energy for very low-intensity exercise. Proteins from muscle are the last fuel to be utilized. These catabolic hormones can break down muscle protein into amino acids, which may also be used as fuel.

Anabolic Hormones

Anabolic hormones actually build up the bodies stores of useful fuels. The most common anabolic hormone is insulin. Insulin has the ability to transport glucose to the muscle cell and enhance glycogen production. It also increases blood flow to the muscle.

Many athletes attempt to stimulate the production of insulin just prior and just after a major workout in an attempt to take advantage of the positive aspects of insulin. However, when you spike your blood sugar you actually over stimulate the release of insulin and your blood sugars will drop as quickly as they rise and will fall into the hypoglycemic range. Even though the rising blood sugar following a high-

glycemic meal or snack will stimulate the release of insulin, the low blood sugars that follow will stimulate the release of both epinephrine and cortisol in an attempt to bring this blood sugar back up to normal. So not only is the intensity of your exercise activity increasing the levels of cortisol and epinephrine but you also increase these levels by spiking your blood sugar. Therefore, in an attempt to raise your insulin levels you are actually increasing those catabolic hormones like cortisol and adrenaline. The other dilemma is the fact that insulin is of no good unless there is a consistent level of glucose available to be transported into the muscle cell. Spiking your blood sugar only allows the blood sugar to remain elevated for 15 to 20 minutes before it drops into the hypoglycemic range.

High levels of cortisol not only significantly suppress your immune system but also can dramatically slow muscle recovery after exercise. It is important to realize that athletes walk a tightrope when they try to stimulate the release of insulin by consuming high-glycemic carbohydrates. There is a much better way to fuel your muscle cells to optimize your workouts, competitive ability, and recovery from both and that is by consuming low-glycemic carbohydrates along with the good protein and fat prior, during, and just after your workouts or competition.

Optimal Nutrition for Peak Performance

Whether you are trying to fuel your muscle cells for an intensive workout or a competitive event, you will want to take into consideration all of the scientific principles that have just been presented. This is not only critical for your performance but also for your recovery. Now the next Healthy for Life Newsletter will focus on specific recommendations for which nutrients to consume before, during, and following your workout or athletic performance. It will also address the concept of nutrient timing for peak performance and recovery. However, this month's newsletter focuses on the importance of learning all the different aspects and consequences of providing the proper fuel to the muscle cell.

Continual supply of Glucose—Low-glycemic Meal

One of the major principles that you must understand is the fact that you want to provide the muscle cell with a steady, continuous supply of glucose. The reason that this is critical is the fact that this is the most desirable fuel source and it allows you the absolute best opportunity to optimize your performance without jeopardizing your recovery.

When you eat a meal, snack, or nutritional drink that contains the good low-glycemic carbohydrates, good proteins, and good fats, you do not spike your blood sugar. The blood sugar rises slowly; however, you do still stimulate the release of insulin. However, you do not OVER stimulate the release of insulin. Therefore, you get all the benefits of the anabolic affects of insulin like transport of glucose into the cell and the stimulation of glycogen production. The blood glucose level remains elevated for 2 to 4 hours normally and will remain elevated for 1 to 3 hours even during moderately intense exercise. This allows the muscle cell to receive a continuous supply of glucose for aerobic production of ATP. You will only use the anaerobic system (Creatine phosphate and glycolysis) for fuel production during bursts of intense exercise. This intense burst of exercise cannot physically be maintained for any great length of time. Therefore, you would normally return to moderate intensity level and return to this aerobic system.

A good example would be a soccer player or hockey player who may be jogging up and down the field or skating up and down the ice. Then there will be an intensive burst of energy as they receive the ball or puck as they are sprinting or skating as fast as they can. After

their involvement in the play is over, they will return to a modest pace and may even find themselves slowing down to recover their breath. When they are involved in modest activity, they will utilize the aerobic system and when the intense burst of activity comes they need to rely on the anaerobic fuel. Obviously, you will return to modest intensity and begin using glucose again, which is being continually supplied to the muscle cell. This will minimize the use of the glycolysis system, which has a byproduct of lactic acid and quickly leads to muscle fatigue.

Contrast this with a high-glycemic meal where athletes are actually trying to spike their blood glucose level to stimulate the release of insulin. The blood sugar remains above the fasting blood sugar level for 15 to 45 minutes normally and 10 to 20 minutes during intense exercise because you have just over stimulated the release of insulin. The blood glucose then falls into the hypoglycemic level (low blood sugar). This immediately cuts off any source of glucose for fuel for the muscle cell. Now the muscle cell must primarily rely on the anaerobic fuel system for both intense and moderate exercise activity. Since there is only an 8 to 12 second supply of creatine phosphate, it is quickly used up and the only option is the use of glycolysis. This will produce a tremendous amount of lactic acid, which will lead to muscle fatigue and decreased performance.

Now in this situation where the body does not have a supply of glucose there will be a release of the catabolic hormones like epinephrine and norepinephrine, which will further stimulate the utilization of the glycogen stores and breakdown of fat. However, as you will recall, fat is not a very good source of energy for the muscle cell in moderate to highly intense activity. At the same time, there will be a significant stimulation of cortisol, which will not only stimulate the breakdown of fat but also muscle protein. So now you are facing the situation you were actually trying to avoid when you consumed the high-glycemic meal or snack. The high levels of cortisol along with the stimulation of the anaerobic energy system. The high levels of cortisol along with the high lactic acid levels in the muscle will dramatically decrease your athletic performance and slow muscle recovery following your exercise.

Now that you are beginning to understand the importance of not spiking your blood sugar, my next newsletter will focus on understanding the glycemic index and glycemic load. This will clearly educate you on which foods you will need to avoid and which ones you need to be consuming. I will also discuss the concept of nutrient timing, which will optimize not only your athletic performance, but also your recovery.