The efficiency of energy conservation during fatty acid oxidation is about the same as glucose, which is about 40%. Approximately 30-80% of the energy required for the body's cellular work is supplied from lipids either stored in cells or available from extra cellular resources.

How Exercise Improves the Oxidation of Fat

Exercise-trained and fit individuals definitely burn and oxidize fat more efficiently than those who do not train and who for whatever reason, are not physically fit. Regular training creates physiological adaptations and provides numerous metabolic advantages that make exercise and fitness the absolute best intervention known for this purpose.

Exercise increases the actual number of mitochondria throughout the entire skeletal system. It also causes an increase in the number of fat-burning enzymes within them. Muscle fibers that contract with force throughout a full range of natural motion need energy. Provided enough blood glucose is present in the blood to "roast" lipids, fat stored throughout the body can be utilized continuously as a substrate for ß-oxidation, especially post-workout when plenty of oxygen is available. Carbohydrate management cannot be overstressed. Fatty acids are also delivered more efficiently to muscle through a larger network of capillaries, which improves blood flow and the exchange of oxygen.

Check This Out

As oxygen uptake increases during exercise in well-trained persons (ml/min/kg) less glucose and glycogen are burned compared to non-trained exercising individuals, with twice the triglycerides and three times as many free fatty acids being utilized by the fitter participants (Saltin B, Astr PO. Free fatty acids and exercise. Am J Clin Nutr 1993; 57(suppl): 752S-8S)

Ketones, Ketosis and the Ketogenic Diet

Unlike glycerol, amino acids, and glucose, fatty acids cannot be used as raw material to synthesize new molecules of glucose. However, they can be oxidized into acetyl-CoA molecules, which the liver can condense to form acetoacetic acid. Acetoacetic acid is converted into beta-hydroxybutyric acid and acetone, and collectively, these three substances are called ketone bodies. The formation of ketone bodies is called ketogenesis.

Ketones are not generally formed unless carbohydrate intake is severely reduced or metabolism is impaired, as in certain medical conditions or in diabetes. During periods of fasting, dieting and starvation, the major organs and tissues of the body greatly reduce their oxidation of glucose and depend primarily on fat for energy. The heart and the cortex of the kidneys use acetoacetic acid in preference to glucose to generate ATP. After about a week of total carbohydrate restriction, the brain's cells, which normally use blood glucose as a fuel, use acetoacetic acid for ATP production.

Ketosis is stimulated by increased cortisol secretion and occurs when the concentration of ketone bodies in the blood rises above normal. As ketone bodies begin to accumulate in the blood, a reduction of blood pH may occur if the body is unable to buffer them. Ketone bodies tend to be acidic and as a result of excess accumulation, metabolic acidosis (ketoacidosis) may result. Although ketones do provide an important energy source via the Krebs cycle, their build-up in the blood can lead to muscular weakness and fatigue.

This presents a conundrum of sorts, because our original ancestors (blood type O) consumed a much higher intake of protein (35%) than what the average person eats today. Almost three times more in fact but, and this is a big but, in the form of fresh, hunted wild game meat. Wild game meat was (and still is) higher in protein and micronutrients. It is also significantly lower in total fat and saturated fat than the domesticated meats commonly eaten today. The meat was also eaten raw, dried in the sun without cooking or cooked without much destruction. Today most meat is overcooked and consumed in a completely denatured state.

Wild game and fish is rich in omega-3 fats, whereas terrestrial (dry land as opposed to marine) meats consumed by most North Americans today such as beef, pork and fowl, contain virtually no omega-3s. As a result, the North American diet today typically contains 20-40 times more omega-6 fatty acids than omega-3s.

Our Paleolithic cousins, who often consumed more omega-3s than omega-6s, burned body fat for energy more efficiently and maintained a leaner, more muscular physique with a rapid metabolic rate. Ketosis allowed early human hunters to function with high energy and physical strength in much the same way as other predators and carnivorous animals. You can still see them today, just head down to your local neighborhood gym.

In some medical conditions (epilepsy) and in competitive bodybuilding, achieving a state of ketosis is necessary for optimizing fatty acid catabolism or reducing body fat to extremely low levels. The diet has to be clean for a long time in advance to get the best effect, otherwise the process can be like "hell on earth." Ketogenic diets emphasize a high intake of protein, reducing or completely eliminating carbohydrates and increasing dietary fat.

Volek and Kraemer fed a ketogenic diet (65% fat/10%carbs/25%protein) to athletes for eight weeks to determine the effect on lipid profiles. The diet did not cause any damage to the kidneys, and no negative effects occurred (Colker, C. MD, Protein vs. carbohydrate for performance, MD, Vol. 37, No. 8, 2000, pp. 78-80)

Lipids are mobilized for energy and the increased presence of ketones in the plasma often acts to suppress the appetite. To prevent the loss of lean tissue, higher quantities of protein are recommended during the process, but the big mistake however, is consuming overcooked animal flesh (domesticated) which is highly acidic, devoid in omega-3 fats and extremely high in total fat (unless tuna, white fish, turkey breast, chicken breast and egg whites are used).

This approach may not be ideal for the long term, as hazards associated with increased levels of uric acid, altered electrolyte levels, and