Enhancing Athletic Performance

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Contributing Editor

Food is the fuel that drives athletic performance, promotes training gains and helps an athlete recover rapidly for their next workout. "Nutrition can make a great athlete good or a good athlete great," notes Amanda Carlson Phillips, director of performance nutrition & research, Athlete's Performance, Phoenix.

Like most aspects of nutrition, sports nutrition isn't a simple science where one recommendation fits all. However, there are some standout foods and sports supplements that can fuel athletes to new levels.

Carb connections

Carbohydrates from blood glucose and stored glycogen are the main fuel source for exercising muscles. And, running low on muscle glycogen is one of the main causes of fatigue in athletes (*British Journal of Sports Medicine*, 2005; 39:34-38; *American Journal of Clinical Nutrition*, 1995; 61:968S-979S). Conversely, by maximizing pre-exercise glycogen stores (carbohydrate stored in muscle and liver), time to fatigue is delayed (*Sports Medicine*, 2007; 24:73-81). This can be done by consuming adequate carbohydrate every day (this varies depending on the training program and size of the athlete) and by consuming carbohydrate immediately after an exhaustive bout of exercise, preferably a high-glycemic carbohydrate that is stored quickly as glycogen.

High-glycemic carbohydrates also help promote training gains in the weight room by increasing insulin secretion, an anabolic hormone that promotes synthesis of muscle protein, decreases protein breakdown, and enhances glucose uptake and glycogen storage (*Diabetes*, 1999; 48:949-957; *American Journal of Physiology: Endocrinology and Metabolism*, 2001; 281:E197-E206). Something as simple as sugar, taken in the form of a sports drink, gel, gummy or other similar products, can promote greater gains in lean body mass and faster recovery (*Journal of Strength and Conditioning Research*, 2003; 17:187-196).

Mining mineral salts and electrolytes

Sodium is the main electrolyte lost in sweat, followed by potassium, magnesium and chloride (*Medicine & Science in Sports & Exercise*, 2009; 41(3):709-731). Replacing lost sodium is absolutely critical, as hyponatremia, a low concentration of sodium in the blood, can be dangerous, even resulting in death (*British Journal of Sports Medicine*, 2006; 40:320-325). For this reason, sodium, or all four of these electrolytes, are formulated into many sports-nutrition products.

Sports beverages

Replacing fluid losses is essential for preventing dehydration, heat illness, decreased athletic performance and rhabdomyolysis, a potentially dangerous injury to skeletal muscle (*Medicine and Science in Sports and Exercise*, 2007; 39:377-389; *Annals of Clinical Biochemistry*, 2000; 37:581-587). In fact, losing just 2% of body weight through sweat can reduce athletic performance (*International Journal of Sports Nutrition and Exercise Metabolism*, 2008; 18:457-472). Hypohydration also affects strength and power athletes, and

can decrease strength by 2%, power by 3% and high-intensity endurance performance by about 10% (*Sports Medicine*, 2007; 37:907-921).

Though water can adequately replace fluids during short bouts of activity, a sports drink that contains electrolytes and carbohydrates should be used in activity lasting longer than 60 minutes (*Medicine and Science in Sports and Exercise*, 2007; 39:377-389; *Sports Medicine*, 2005; 35:163-181). The ideal sports beverage contains approximately 460 to 1,150 mg sodium per liter, 78 to 195 mg potassium per liter and a carbohydrate concentration of 6% to 8% ("Dietary Reference Intakes for Water, Sodium, Chloride, Potassium and Sulfate," Institute of Medicine, 2005; *Sports Medicine*, 2005; 35:163-181). Either water plus foods that contain sodium and chloride, or a sports drink, should also be consumed after exercise to make up for fluid and electrolyte losses ("Sports Nutrition: A Practice Manual for Professionals," American Dietetic Association, 2006).

Caffeinated performance

Caffeine is a multifaceted ergogenic aid that increases mental alertness and improves logical reasoning, free recall and performance in recognition memory tasks (*Appetite*, 1994; 22:39-55). Caffeine can also enhance time to exhaustion during aerobic exercise (*Medicine & Science in Sports & Exercise*, 2003; 35:1,348-1,354; *International Journal of Sport Nutrition & Exercise Metabolism*, 2004; 14:626-646) and decrease ratings of perceived exertion during submaximal aerobic exercise (*Perceptual and Motor Skills*, 2007; 105:1,109-1,116). In addition, caffeine can improve performance in those who are sleep-deprived, and when consumed with carbohydrate it may enhance glycogen synthesis after exercise (*Journal of Applied Physiology*, 2008; 105:7-13). Caffeine can also help decrease muscle soreness after damaging bouts of exercise (*Journal of Pain*, 2007; 8:237-243).

The effects of caffeine on sport performance may be different depending on the form of caffeine; the anhydrous form may be more effective than caffeine consumed in a liquid, such as coffee (*Journal of the International Society of Sports Nutrition*, 2010; 7:5). The effects also depend on the amount consumed, timing of consumption and whether or not the athlete is a habitual caffeine user.

Protein and amino acids

Athletes need 1.2 to 2.0 grams of protein per kg body weight per day to

optimally build and repair muscle tissue and maintain their lean body mass. In addition, for optimal gains in performance and body composition, athletes should time their intake of a good dose of quality protein (*International Journal of Sport Nutrition*, 1998; 8:426-447; *Journal of the International Society of Sports Nutrition*, 2007; 4:8). The amino-acid composition of a protein matters, with protein that contains higher levels of the branched-chain amino acids (BCAAs) being better able to stimulate the processes of muscle-protein synthesis. For this purpose, research has shown that dairy proteins, specifically whey and casein, are the best for stimulating muscle-protein synthesis (*Journal of the American College*, 2009; 28:343-354), although whey may be better than casein (*Proceedings of the National Academy of Sciences*, 1997; 94:14,930-14,935). Soy stimulates muscle-protein synthesis, but it doesn't do so to the same extent as other proteins (*Journal of Applied Physiology*, 2009; 107:987-992). Egg protein is rich in BCAAs and easy to digest, making foods made with eggs or egg protein an ideal source of quality protein for athletes.

BCAAs can enhance muscle-protein synthesis after exercise, decrease muscle-protein breakdown and reduce muscle damage from exercise (*American Journal of Physiology, Endocrinology and Metabolism*, 2004; 287:E712-E720). In addition, providing athletes with BCAAs prior to aerobic exercise will increase the concentration of growth hormone and prevent a drop in testosterone, leading to a more-anabolic environment (*European Journal of Applied Physiology and Occupational Physiology*, 1992; 64:272-277). This is especially important for athletes who need to maintain their lean body mass while burning many calories during long bouts of training. "The beneficial effect of BCAAs on muscle preservation and growth also makes them suitable for anyone wanting to lose weight without losing muscle," notes Jack Voller, marketing manager, Ajinomoto AminoScience, LLC, Raleigh, NC. Finely milled BCAAs can be easily mixed into many food and beverage applications.

Researchers suggest glutamine may be involved in exercise-induced central fatigue and immune suppression ("Overtraining in Sport," Human Kinetics, 1998). "Glutamine by itself is good for the immune system, protecting the GI tract, and providing muscle protection during recovery," says Karen Todd, R.D., marketing director, Kyowa Hakko USA, Inc., New York.

The amino acid alanine is needed to produce glycogen, the storage form of glucose in the body. In muscles, glycogen helps determine endurance performance. "Limited research indicates it can help get fuel back into the muscle cells," says Todd.

Combining these two amino acids as a dipeptide can provide certain advantages. A study conducted by the Department of Health and Exercise Science at the College of New Jersey, Ewing, NJ, showed L-alanyl-L-glutamine (the study used Sustamine™ brand from Kyowa Hakko) increases performance in endurance exercise and activity when exercising to exhaustion in subjects' hypohydrated to 2.5% of body mass. The supplement reduced the magnitude of performance reduction compared to the dehydrated condition, leading researchers to comment on the GRAS ingredient's potential ergo-

genic benefit under exercise and hydration stress (*Journal of the International Society of Sports Nutrition*, 2010; 7:8).

"When you combine alanine and glutamine into a dipeptide, you get a whole different effect," notes Todd. "You get the benefits of the alanine, the benefits of the glutamine, but what we found with this recent study is the hydration benefits—and you don't get that with alanine or glutamine. The dipeptide has its own benefit." About 3.5 grams per day will produce these effects, she says. Hydration is important, she notes "because once an athlete gets down to 1.5% to 2% hydration, performance decreases dramatically.

"Glutamine has been recognized by the sports nutrition industry for many years for recovery and gut health," continues Todd. "But, in the past, it was very expensive and could only be used in parenteral and enteral supplements—high-end products—but Kyowa developed a new fermentation process to bring the cost down," making it affordable for sports supplements. She explains that the dipeptide form is more stable in foods and beverages, because "once you add glutamine into solution, it begins to break down immediately."

Creatine is a molecule derived from the amino acids glycine, arginine and methionine. It does not serve as one of the building blocks of protein in the body; however, it contributes to short-term energy production in muscle. Creatine is both an effective and safe ergogenic aid. Longer-term creatine supplementation, over the course of at least six to eight weeks, when combined with a good resistance-training program, can promote gains in both strength and muscle mass (*Medicine and Science in Sport and Exercise*, 1999; 3:1,147-1,156).

Though individualized nutrition prescriptions should be made for each athlete and take into account an athlete's sport, training program, injury history, medical history, food preferences, lifestyle and goals, functional foods and beverages made for the sports-nutrition market should consider including some of the top ingredients for refueling athletes, helping them recover and make greater training gains.

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