Ergogenic Supplements

What We Know

› Dietary supplements, also referred to as ergogenic supplements, are used by athletes to enhance athletic performance in a variety of ways, including promotion of tissue growth and repair; adaptation to training; fat loss; and improvement of immune function, joint health, and general health. Athletes also use dietary supplements to improve endurance and stimulate the central nervous system by reducing tiredness, increasing alertness, competitiveness, and aggression. Dietary supplements must be used with caution, however, since they are not regulated using the same standards as food ingredients and pharmaceuticals\(^{(5, 8, 9)}\)

• The Food and Drug Administration began to monitor dietary supplements in 1994 as a result of the Dietary Supplement Health and Education Act. However, supplements that do not claim to diagnose, cure, or prevent disease are not subject to the same regulations as pharmaceutical ingredients. Thus, dietary supplements can be inconsistent in quality. Inconsistent quality refers to composition and contamination. For example, dietary supplements may not contain the ingredients listed on the label in the stated strength and amount. Or, they may contain other, harmful ingredients that may cause contamination. Dietary supplements include vitamins, minerals, herbs, amino acids, and meal substitutes\(^{(5)}\)

• A cost-benefit analysis that takes into consideration the efficacy, cost, risk to health and performance, and the potential for adverse outcomes of a doping test should be conducted to determine the value of using supplements to enhance athletic performance\(^{(1, 5, 8)}\)

– Although many supplements may be safe, some may be contaminated with ingredients that are prohibited for use by organizations such as the U.S. Anti-Doping Agency and the World Anti-Doping Agency. Under the principles of the World Anti-Doping Agency, athletes must accept responsibility for the supplements they use\(^{(8)}\). This means they agree that they are accountable for the use of the supplement even if it may inadvertently contain an ingredient that is not allowable.

› Ergogenic supplements can be categorized according to the purpose of the supplement, the food component of the supplement, or by its proven effectiveness\(^{(5)}\)

• Purpose: supplements for weight gain and calorie supply; supplements to enhance sports performance

• Food component: amino acid derivatives, lipid derivatives, and nonessential dietary components (e.g., caffeine, creatine, carnitine, ginseng)

• Proven effectiveness: apparently effective, possibly effective, too early to tell, apparently ineffective, or ineffective

› Creatine monophosphate is a popular dietary supplement used by strength and power athletes (e.g., those engaged in weight-bearing activities such as weight lifting) to increase muscle mass. Creatine has been shown to be effective and primarily safe\(^{(4, 5, 6, 8, 9, 10)}\)

• Creatine is made in the liver and pancreas from the amino acids arginine, glycine, and methionine; about 95% of the body’s creatine is stored in the skeletal muscle in the form of creatine phosphate. Creatine is a natural guanidine compound that can also be obtained through the diet in meats and fish\(^{(5, 8)}\)
The position of the International Society of Sports Nutrition (ISSN) on creatine supplementation is that creatine monohydrate is a safe, effective supplement for athletes seeking to increase their high-intensity exercise capacity and lean body mass during training. Increasing muscle creatine stores can be achieved by consuming about 0.3 grams/kg/day of creatine monohydrate for at least 3 days and then taking 4–5 g/d to maintain the elevated stores.

Caffeine is used by athletes to improve aerobic performance and delay fatigue; it is also considered a fat burner by some. The aerobic performance enhancement is due to its effect on the central nervous system. Data from studies suggest that intakes of 3 mg/kg/day can show performance benefits. Some studies show improvements in performance for strength training while others do not. Studies that show improvements for strength training involved caffeine consumption at the high end of the dose considered to be safe, which is 6 mg/kg/day.

Combinations of caffeine and creatine are consumed by some athletes to enhance strength, power, and lean body mass and improve adaptation to high-intensity exercise. The combination of the two supplements has not shown detrimental pharmacological effects in most studies, but further research is needed.

Beta-alanine
- A systematic review of the literature has indicated that there is some evidence that beta-alanine improves athletic performance. Specifically, the evidence is moderate to high quality that beta-alanine increases power output and total work done, decreases subjective feelings of fatigue and perceived exhaustion, and has positive effects on body composition and muscle carnosine. Muscle contains carnosine; carnosine acts as a buffer, meaning it helps to maintain a normal balance of acidity in the muscles. Fatigue during high-intensity exercise such as weight lifting or sprinting is associated with acid buildup in the muscles. Carnosine helps to prevent this acid buildup. The authors suggest using beta-alanine cautiously since there are no long-term studies confirming its safety.

Nitric oxide is an important signaling molecule that is involved in the regulation of muscle blood flow and mitochondrial respiration. The ingestion of nitrate or beetroot juice increases the level of plasma nitrate, which stimulates the production of nitric oxide. Nitric oxide can also be stimulated through endogenous nitric oxide synthesis from L-arginine.
- Nitrate is found in abundance in green leafy vegetables (lettuce, spinach, rocket, celery, cress) and beetroot.
- After ingestion nitrate is converted to nitrite and circulated in the bloodstream.
- When oxygen availability is low, nitrite can be converted to nitric oxide, which is essential to vascular and metabolic functions.
- Nitrate supplementation increases blood plasma nitrite levels and decreases resting blood pressure.
- Research suggests dietary nitrate supplementation is beneficial in enhancing muscle efficiency and oxygenation, but more research is needed to determine the conditions for which supplementation is optimal.

L-arginine has been shown to improve aerobic endurance exercise performance by increasing plasma levels of nitrates and reducing oxygen consumption during less than maximum exercise, as indicated by heart rate.
- Arginine is believed to positively affect blood flow, protein synthesis, and exercise performance, although this requires further research; however, some athletes still take doses of about 20 g/d, which appears to be a level that is not harmful.

Alkaline agents (sodium bicarbonate and sodium citrate) have been shown to improve anaerobic endurance performance by increasing pre-exercise pH and increasing extracellular buffer capacity.
- Increased acidity within the muscle cells is a major component of fatigue. Adding an alkaline agent reduces the negative effects of acidity.
- These supplements are most relevant to athletes engaged in activities that have a high anaerobic demand with a high amount of anaerobic glycolysis, such as medium-distance running.
- The recommended dose is 0.3 g/kg body weight.

The National Athletic Trainers Association offers the following guidelines for dietary supplements and performance nutrition.
- Athletic performance can be enhanced through nutrition; proper nutrition and changes in the diet should be considered before supplementation.
- Athletes need to be aware of and understand how supplements are regulated and not regulated (i.e., that supplements are not regulated the same way as pharmaceutical ingredients when the supplements do not claim to diagnose, cure, or prevent...
They should not make assumptions about the safety of a product based on the fact that it is available and is being marketed.

• Athletes should evaluate the level of purity, safety, and efficacy of all supplements they wish to consume by looking for the program mark or seal of ConsumerLab.com, NSF International, and the U.S. Pharmacopeial Convention (USP).

– These organizations administer certification quality programs in the United States that evaluate the quality, purity, potency, composition, and other criteria of dietary supplements. Products must meet acceptable limits for potential contaminants and not contain harmful levels of toxic botanical species. Further, they cannot contain amounts of the active ingredient that are greater or lesser than that listed on the label\(^2\).

**What We Can Do**

› Learn about ergogenic supplements so you can accurately assess your client’s personal characteristics and health education needs; share this information with your colleagues

› Educate clients on the benefits and risks associated with using ergogenic supplements to enhance their athletic performance

› Remind clients that supplements cannot compensate for poor food choices and/or an inadequate diet\(^2\).

**Related Guidelines**

*National Athletic Trainers’ Association position statement: Evaluation of dietary supplements for performance nutrition*
References


