



Muscular Pump, Growth & Performance

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Literature Education Series On Dietary Supplements

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Have you ever said or thought, “My muscles are pumped? Okay, so what does it really mean to have pumped muscles? The answer to this question was given in an article in-press I recently had the opportunity to read by Vince Andrich, a brilliant fitness writer. In the article, Andrich¹ has described ‘the pump’ as a term used in bodybuilding circles to describe the sensation of tight congestion, or swelling, of your muscles with blood coursing through them during your weight training session. Andrich further explained that the magnitude of the pump is a function of multiple factors, and is related to a cellular swelling mechanism described as osmotic anabolic signaling² (OAS).

Reading the article caused me to consider what natural substances might influence OAS. This led me to thinking about what natural substances might positively impact muscle growth in general, reduce the breakdown of muscle tissue (i.e., have an anti-catabolic effect), and promote performance. (Sorry, that’s the way my mind works. One thought leads to another and I just can’t stop thinking.) In any case, I did a little research, and wrote this current article to address natural substances that do all of these things. Let’s begin with glycerol.

Glycerol

In the bodybuilding community, glycerol is often used to promote the appearance of muscle volume and vascularity (sort of a “shrink-wrapped” look): essentially a pumped muscle. These effects are based on glycerol’s osmotic properties, which involves the ability to hold onto water, providing a hydrating effect.³ According to Gastelu and Hatfield, glycerol

seems to act like a sponge, absorbing water into the bloodstream and holding it there.⁴ Some research has shown that glycerol might even positively impact performance. In one study, Olympic distance triathlon athletes achieved hyperhydration with glycerol, and were able to run cooler for a longer period of time in hot temperatures.⁵ Likewise, in another study glycerol was found to significantly increase water retention over water alone in athletes tested.⁶

Leucine

Leucine is one of the three branched-chain amino acids. Because of an increase in leucine breakdown that occurs in the muscle during exercise, studies have linked the effects of leucine supplementation on performance. In animal research, leucine supplementation was found to increase protein synthesis.⁷ In human clinical research, leucine was found to decrease the breakdown of muscle tissue.⁸

Leucine, isoleucine & valine

The branched-chain amino acids (BCAAs) are leucine, isoleucine and valine. The BCAAs have been shown to have various functions such as promoting protein synthesis in skeletal muscle, and as the primary amino acid fuel for muscle and other tissues.⁹ BCAAs have also been shown to significantly reduce the breakdown of skeletal muscle in normal volunteers.¹⁰

Several studies suggest that supplementation with BCAAs have in an ergogenic effect. In one study, exercising individuals had a 1.5% increase in lean body mass with BCAAs, while those individuals using a placebo has no change in body mass.¹¹ In addition, those using BCAAs were also able to lessen the drop in muscular power.

In another study of highly trained exercising subjects, those using BCAAs did not have a significant loss in body weight, while those in the placebo group had a 2.1% loss of body weight. In addition, peak power decreased in the placebo group, but not in the BCAAs group.¹² In a study of healthy, untrained

individuals using BCAAs, fat-free mass and grip strength had a significant increase (1.3%).¹³

Tyrosine

Stress can impair performance. Due to its role as a precursor to norepinephrine and epinephrine (two of the body's main stress-related hormones) tyrosine may ease the adverse effects of environmental, psychosocial, and physical stress.^{14 15 16 17 18 19 20}

20-Hydroxyecdysterone

20-Hydroxyecdysterone belongs to a class of natural substances called phytoecdysteroids (i.e., plant-based steroids). Phytoecdysteroids are active in protein biosynthesis (anabolism) by increasing the activity of polyribosomes. Polyribosomes are the cytoplasmic compartments within cells where actual protein synthesis takes place. The result is an increase in body mass.²¹

In animal research, 20-Hydroxyecdysone extracted from *Rhaponticum carthamoides* resulted in a 115% increase in developing body mass.²² In other animal research 20-Hydroxyecdysone caused statistically significant increases in skeletal muscle mass and muscle protein content.²³ Studies in Russia on human subjects found that under conditions of aerobic-anaerobic training for three weeks, 20-Hydroxyecdysterone was able to diminish body fat content, while elevating muscle mass.²⁴ A similar study found that a combination of 20-Hydroxyecdysterone with a protein supplement given to athletes resulted in up to a 13.71% reduction in fat content, together with up to a 7.10% increase in muscle tissue mass (compared with up to a 2.99% decrease in muscle in the placebo group).²⁵ Yet another study conducted on 117 highly qualified speed skaters also demonstrated that *Rhaponticum* (an herb containing 20-Hydroxyecdysterone) was able to increase anabolic protein metabolism, and body weight.²⁶

4-hydroxyisoleucine

Athletes need to drive glucose into muscle tissue for growth and recovery. This is one of the jobs of the hormone insulin, which may explain why some non-diabetic bodybuilders have been following the extremely dangerous practice of injecting insulin to achieve an anabolic effect (nothing in bodybuilding can kill you faster if used improperly). Luckily, there is a safer way to potentiate the secretion of insulin. A natural substance known as 4-hydroxyisoleucine, a form of the amino acid isoleucine extracted from fenugreek seeds, has insulinogenic or insulin potentiating effects, as demonstrated in animal research.^{27 28 29} Other animal research³⁰ has shown that 4-hydroxyisoleucine also significantly decreases triglyceride, cholesterol and free fatty acid levels. Additional animal research showed 4-hydroxyisoleucine body weight gain in mice fed a

high fat diet, and also lowered their triglycerides.³¹ In human athletes, 4-hydroxyisoleucine given with a glucose beverage was found to increase glucose and insulin concentrations after exercise, as well as resynthesize glycogen more effectively than glucose alone.³²

Caffeine

Caffeine can improve mental performance and alertness following prolonged sleep deprivation.³³ The FDA³⁴ recognizes that caffeine is a stimulant that “helps restore mental alertness or wakefulness during fatigue or drowsiness,” and identifies it for this purpose in its monograph on over-the-counter stimulants. In addition, Lorist and Tops³⁵ have indicated that caffeine is regarded as a mild stimulant with benefit for fatigue.

Caffeine also seems to increase physical endurance³⁶ as well as increase the time to exhaustion during physical exertion.³⁷ Likewise, Van Gammeren³⁸ has reviewed numerous studies that demonstrate caffeine's benefits for endurance and performance.

Furthermore, Miller, Lombardo and Fowler³⁹ demonstrated that caffeine helps increase energy levels at certain times during the day; and other research on caffeine has shown that it prevents a decline in alertness and cognitive capacity when consumed throughout the day.^{40 41}

Chromium polynicotinate

Chromium helps insulin metabolize fat, turn protein into muscle and convert sugar into energy. Chromium-activated insulin increases the amount of blood sugar available for energy production nearly twenty-fold. Chromium polynicotinate is niacin-bound chromium that dramatically increases the effectiveness of chromium.⁴²

Due to its interaction with insulin, chromium polynicotinate has been found to improve fasting glucose levels in human subjects.⁴³ In a study conducted on athletes, total power output was significantly higher for the group consuming a carbohydrate-electrolyte beverage with chromium polynicotinate, compared to those just consuming the carbohydrate-electrolyte beverage.⁴⁴ Research has even shown that chromium polynicotinate influences genes promoting muscle development and lean body mass, as well as improving lipid profiles.⁴⁵

Rhodiola rosea

For centuries, *Rhodiola rosea* has been used in Russia, Scandinavia, and other countries to increase physical endurance, work productivity, to treat fatigue, and for a variety of other purposes.⁴⁶ Modern scientific studies in cell cultures, animals, and humans have revealed anti-fatigue, anti-stress, anti-hypoxia (protection against damaging effects of

oxygen deprivation), and antioxidant, effects.^{47 48 49 50}

^{51 52} Of particular note are Rhodiola's anti-fatigue and performance enhancing properties. A number of studies have shown that Rhodiola increased physical work capacity and dramatically shortened the recovery time between bouts of high intensity exercise.⁵³

Alpha lipoic acid

Research has demonstrated that natural antioxidant Alpha Lipoic Acid (ALA) can support healthy blood glucose levels; with individuals given ALA having significantly greater insulin-sensitivity, and improvement in insulin-stimulated glucose disposal.⁵⁴ Also, research has shown that ALA provides significant antioxidant defense against oxidative stress.⁵⁵

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