

Supplement Performance

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Pre-Exercise Supplementation

Part 2: Peripheral Fatigue

In a perfect world, you would be motivated to work out at least three to four times a week, you would feel energized at every workout session and you'd feel intense, focused and ready to push yourself a little more than your last workout. Ideally, over a few months, you would really start to see the results you were working so hard for and your goals and dreams would start to become reality. Unfortunately, your exercising life doesn't always work out quite the way you planned it. And although there are many reasons why you're not making progress in your training and reaching your goals, a large reason is due to fatigue.

Fatigue, at both the central (brain) and peripheral (nerves and muscles) level, is a major limiting factor that is stopping or slowing you from blasting through your workouts feeling energized, strong and focused. Defined simply, fatigue is the inability to maintain a power output or force during repeated muscle contractions. We've all felt fatigue, some days more than others. Some days we feel fine, but just aren't making progress in our workouts. That's because fatigue can operate below the conscious surface, and through a series of chemical reactions (or lack of reactions), we could actually be functioning at a level well below baseline. This can lead to fatigue, lack of motivation, workout plateaus and overall, generally impede us from getting the best

results from our workouts.

In part one, we explained central fatigue and the factors that affect it, which in turn affect exercise performance. We also discussed the benefits of important pre-exercise supplementation and how effective it can be at combating central fatigue. In fact, specific nutrients, ingested prior to exercise, assist in creating an optimal mental state that consistently fuels training progress. They put you in the "zone."

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Specifically, it's a group of neurotransmitters, members of the neuroendocrine system that, when stimulated, promote optimal exercise performance and fight fatigue. With a solid understanding of the nutrients that fight off central fatigue, you can help your body achieve a peak mental state for every workout, consistently maximizing your progress and forcing results.

Peripheral Fatigue

Central fatigue isn't the only enemy, however. Peripheral fatigue, or

fatigue outside the central nervous system, can also make you feel weak and tired, but for different reasons. Fortunately, peripheral fatigue can also be attacked, with the right nutritional approach. Unlike central fatigue, which is primarily controlled by chemicals in the brain, peripheral fatigue is primarily affected by neural, mechanical and energetic factors within or around the muscle. We'll focus on neural factors and, specifically, two sites of neural fatigue: the neuromuscular junction and the sarcolemma. These are two hot spots that determine the strength of a muscle contraction, and fortunately they, too, can be influenced by the right pre-exercise nutrients, potentially making you stronger and more powerful at every workout.

Before we discuss how pre-exercise nutrients can boost your strength, let's review the properties of a motor unit. Each skeletal muscle cell is connected to branches of nerve cells called motor neurons coming from the spinal cord. By definition, a motor neuron and all the muscle fibers it innervates is called a motor unit. Just as the name motor neuron suggests, these are nerve cells that stimulate or drive muscular contraction. However, at the site where the motor neuron and muscle cell meet, there is no actual contact. Instead, we arrive at what's known as the neuromuscular junction. This is where a traveling nerve impulse, when it reaches the end of

Supplement Performance

the motor nerve, causes a release of the neurotransmitter acetylcholine, which then crosses the neuromuscular junction and enters the muscle cell. It's acetylcholine that triggers the chain of events that leads to powerful muscular contractions.

Ultimate Combination For Acetylcholine Synthesis

So, acetylcholine is a critical neurotransmitter in the peripheral nervous system. If it doesn't travel across the gap between the motor neuron and the muscle cell, there is no muscular contraction. Recent research shows diminished acetylcholine levels with exercise could be a contributing cause of muscular fatigue and poor workout performance. So, ensuring adequate acetylcholine levels could be crucial for optimal muscular performance. But acetylcholine is not a one-trick pony! It not only impacts the muscles, as we just discussed, but it's vital to brain function, too. (As discussed previously, brain function and the mental aspects of training is every bit important as muscular performance.) Thus, acetylcholine serves double duty, affecting muscular contraction and neurological processes, both of which are essential components of exercise performance.

You might be wondering if there are ways to provide the body with substances that can act as precursors to acetylcholine and the answer is YES! Two such nutrients that act as acetylcholine precursors are L-alpha-glycerylphosphorylcholine (alpha-GPC) and acetyl-L-carnitine. Alpha-GPC is a highly advanced delivery form of choline. By providing the choline component, it acts as a precursor to the formation of the all-important acetylcholine. (Remember, once it reaches the muscle cell, the cascade

of events that lead to muscular contractions start.) With acetyl-L-carnitine, a substance with a large range of neurological and potentially hormonal effects, the results are similarly prolific. This unique form of carnitine is able to cross the blood-brain barrier and act as an acetylcholine precursor by donating its acetyl group. Combine a deliverable form of choline from alpha-GPC with an acetyl donor from acetyl-L-carnitine, and you create the ultimate combination in precursors for acetylcholine synthesis.

Fight Free Radicals With Antioxidants

So far, everything up to this point has described the process happening between the nerve and the muscle cell. But the potential for fatigue doesn't end there. Fortunately, neither does our ability to fight it. Another site of peripheral fatigue is the calcium storage sites known as the sarcoplasmic reticulum (SR), another step in muscle contraction.

Before we get into why this is a trouble spot, and what you can do to target it, bear with us while we give a brief description of what this is and what it does. For those of you who aren't interested in all of the science and just want the bottom line, don't worry...it's coming soon! The SR is located within a portion of the cell membrane called the sarcolemma, which surrounds a muscle cell. Once the muscle cell is initially stimulated by acetylcholine, this stimulation or excitation, travels deep into the muscle cell and reaches the SR. When the SR is stimulated, it releases calcium, allowing the two protein filaments—myosin and actin—to interact and shorten, causing a muscle contraction. This whole sequence of events, though highly summarized, beginning from the nerve impulse to the actual shortening of the muscle cell is called

“excitation-contraction coupling.”

Scientific research has soundly established that tissue damaging, reactive oxygen species (ROS) called “free radicals” are increased during exercise. While free radicals are a necessary process of physiology, recent studies have shown that elevated levels during exercise may actually contribute to muscular fatigue. One theory suggests that free radicals contribute to fatigue by damaging the SR, causing less calcium to be released. Quite logically, this could greatly interfere with and diminish optimal muscular contraction.

One way to fight elevated free radical production during exercise is by increasing your intake of antioxidants such as vitamin C or plant extracts such as green tea or grape seed extract. Green tea is one of the most effective sources, boasting a huge range of powerful antioxidants called catechins. Catechins have been shown to generate a wide array of antioxidant activity and are able to fight many different types of free radicals. Few plants can compare to green tea extract.

Beta-Alanine Delays The Onset Of Neuromuscular Fatigue

Another highly effective ingredient that has repeatedly been shown in research to delay the onset of neuromuscular fatigue is beta-alanine. As we exercise, our energy systems and lactic acid release hydrogen ions (H+). Hydrogen ions cause our muscles' pH to drop (become more acidic). A decrease in muscular pH interferes with the muscular contraction process in multiple ways. Beta-alanine delays neuromuscular fatigue by boosting a powerful H+ buffer in our muscles called carnosine. Boosting carnosine levels helps stabilize muscular pH and

Supplement Performance

delays the onset of neuromuscular fatigue. While beta-alanine isn't necessary a preworkout supplement, as it needs to be taken continuously to build up carnosine levels, it is relevant to mention it, as it does impact performance at the neuromuscular level.

Summing Up

We know that fatigue is our enemy, getting in the way of optimum workouts and rapid gains. We've identified two types of fatigue— central and peripheral. Central fatigue, originating in our brain and central nervous system, affects our mental state, or how we feel and has real and profound effects on our physical performance. Stimulants (such as caffeine) and adrenaline precursors (like tyrosine and TMG) may combat central fatigue, making us feel better and ultimately

perform at our peak. Peripheral fatigue, on the other hand, is occurring between nerves and our muscles. The latest research suggests that diminished acetylcholine and impaired SR functioning caused by exercise-induced free radical production can be contributing factors to peripheral fatigue. Nutrients such as alpha-GPC, acetyl-L-carnitine, antioxidants such as green tea and beta-alanine help fight peripheral fatigue, helping us stay energized and focused, maximizing our workout sessions.

Combining the information from these two articles, hopefully you were able to get a clear picture of the importance of pre-exercise supplementation and how critical it can be in helping you achieve your fitness goals. We believe pre-exercise supplementation, along with a post-

workout supplement, should be a staple to anybody who is serious about working out and making progress. With the right pre-exercise nutrients, you can have a profound effect on central and peripheral fatigue though neuroendocrine support, neurological support, neuromuscular support and antioxidant support.

In summary, the nutrients that affect central and peripheral fatigue, reviewed this month, and last month, are:

- Tyrosine
- Caffeine
- TMG
- Alpha-GPC
- Acetyl-L-carnitine
- Antioxidants
- Beta-Alanine ⁿ

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