



NeuX Model: Barry Kabov

More Grow Power

Repping Into the Mass Zone
With Beta-Alanine Part 1 by Jerry Brainum

Not a day goes by without another new “revolutionary” sports supplement being offered to bodybuilders. Some supplements have value, but others are based on either poor or nonexistent science. Occasionally, however, a supplement appears on the market that works precisely as advertised. Case in point: creatine. Its effectiveness is confirmed by countless scientific studies, and most scientists agree that it works for 80 percent of those who use it.

What makes creatine especially enticing for bodybuilders is that it’s almost specific for bodybuilding. Bodybuilding training is anaerobic, meaning that it relies on energy systems that differ from those of aerobic exercise. Creatine not only helps maximize muscle efficiency for anaerobic exercise but also helps delay fatigue in working muscle. Add to that creatine’s promotion of anabolic, or growth, reactions in muscle, and you can see why it is so popular among bodybuilders and other athletes who engage in short, high-intensity workouts.

One way that creatine helps increase training intensity is through a buffering action in muscle. The onset of muscle fatigue during any high-intensity set is heralded by a burning sensation in the trained muscle, caused by an accumulation of lactic acid, a by-product of anaerobic energy metabolism. Recent research confirms that acid protons, not the lactate portion of the compound, are the primary cause of muscle failure.

Buildup of acidity in muscle throws a metabolic

monkey wrench in the energy machinery of muscle. When enzymes involved in muscle energy production are inhibited, the muscle can’t function until the excess acidity is cleared away. The body’s buffer mechanisms neutralize excess acidity.

In the blood, the primary buffer is sodium bicarbonate, or baking soda, along with various proteins and hemoglobin. Several studies have demonstrated that it can function as an ergogenic aid to decrease muscular fatigue. On the other hand, the amount of sodium bicarb the body needs for that (300 milligrams per kilogram of bodyweight) is uncomfortably close to the dose that produces such unpleasant side effects as explosive diarrhea. Gastrointestinal discomfort, bloating and cramps are related to the sodium content, and bicarb reacts with hydrochloric acid in the stomach, generating a large amount of carbon dioxide that distends the stomach wall and leads to bloating. Drinking more water diminishes those side effects, and you have to take the bicarb one hour prior to activity.

Sodium bicarb isn’t an efficient ergogenic aid for bodybuilding, however, because it works best for exercise or activity that lasts one to seven minutes. The average bodybuilding set lasts less than 20 seconds.

Bicarb’s high sodium content promotes water retention—taboo for any bodybuilder. In susceptible people, retained sodium can precipitate high blood pressure, with all its attendant negative health effects, particularly on the cardiovascular system. Other substances that retain sodium and water in the body, such as anabolic steroids, aggravate the effect.



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Neveux Model: Dave Goodin

Other substances make it possible to avoid the high-sodium levels of sodium bicarb—for example, potassium bicarb. Potassium's alkaline properties help reduce excess acidity, but potassium bicarb is far less readily available than sodium bicarb. What's more, release of potassium from working muscle is implicated in muscle fatigue, and high blood levels of potassium could have adverse effects on normal heart rhythm.

Another problem with bicarb buffers—sodium bicarb, as well as phosphate and citrate—that makes them not very useful for bodybuilding training is that they work only in the blood. They cannot diffuse into muscle, the true site of fatigue, in sufficient amounts to be effective. So while useful for decreasing blood acidity levels, they do little or nothing to dispel muscle fatigue.

A true intramuscular buffer could have enormous effects on workout efficiency and muscular gains. Muscle contains natural, built-in buffers to deal with high-acidity levels, primarily carnosine. Carnosine was so named because it was discovered in meat—which is muscle—back in 1900 by Russian scientists. Later research showed that it's a dipeptide, meaning that it consists of two bonded amino acids, beta-alanine and L-histidine. Beta-alanine is found in small amounts in protein, such as chicken, and in humans it's a by-product of the metabolism of nucleic acids. It also forms part of the structure of the B-complex vitamin pantothenic acid. When metabolized, beta-alanine degrades into acetic acid, better known as vinegar.

L-histidine is a common amino acid. It's the precursor of the chemi-

cal histamine, which plays a role in allergic reactions and sexual orgasms. Histamine is a potent dilator of blood vessels lying just under the skin, an uncomfortable but harmless effect you see when you take a large dose of the vitamin niacin and your skin flushes.

Carnosine is synthesized in muscle from beta-alanine and histidine through the actions of carnosine synthetase. The enzyme that degrades carnosine, known as carnosinase, is present in kidneys, liver and blood plasma but not in muscle.

Carnosine is valuable to those engaged in intense training because it buffers, or neutralizes, excess acid produced during anaerobic metabolism. High levels of carnosine in muscle yield increased muscular strength, endurance and recovery, which means you can train much harder before muscle fatigue sets in.

So if carnosine is such an efficient ergogenic aid, it would make sense to take carnosine supplements—or would it? Carnosine supplements are quite expensive. Even worse, because carnosinase is ubiquitous, taking carnosine orally would likely have little effect on muscle buffering. Those who consistently exercise also experience increased carnosinase activity.¹

One way to overcome the enzyme barrier would be to inject carnosine directly into muscle. A prominent trainer who does that with his athletic clients reports excellent results. On the other hand, carnosine injections are not commercially available and must be specially prepared by a lab or pharmacy. Another way to overcome the carnosinase barrier is to use a form of carnosine not susceptible to degradation, such as N-acetyl-carnosine. So far, however, that is used only in carnosine-based eye drops.²

You might take the individual components of carnosine—beta-alanine and histidine—and hope that they convert into carnosine in muscle. Beta-alanine and histidine alone provide no buffering effects; they become active only when enzyme action converts them into carnosine.

Studies have shown that what limits carnosine synthesis in the body isn't histidine, which is found in nearly all protein foods, but the far rarer substance, beta-alanine. Muscle apparently contains enough histidine to provide the necessary substrate for carnosine synthesis, provided that beta-alanine is also present.



A Closer Look at Carnosine

Scientists first became aware of the potent buffering effects of carnosine in 1953, during experiments with isolated frog muscle, the results of which showed that when exposed muscles were infused with carnosine, they accumulated large amounts of lactic acid without any notable signs of fatigue. Later studies proved the existence of carnosine in human muscle, especially in type 2 muscle fibers, the fast-twitch fibers that are most prone to both growth and fatigue. The initial enthusiasm for carnosine was tempered by a 1992 study that showed it to contribute only 7 percent to human muscle-buffering capability. But an earlier study suggested that carnosine and its methylated version, anserine, contribute more than 40 percent of muscle-buffering capacity.³ Anserine, by the way, is found in many species of animals, such as chickens, but doesn't occur in human muscle and would thus be useless as a supplement.

Carnosine has other properties useful to both exercise and health. In addition to the buildup of acidic protons, muscle fatigue is caused by increased levels of by-products of oxygen metabolism known as free radicals, unpaired electrons that inhibit energy systems in muscle and that are involved in delaying muscle recovery after training, as well as by the buildup of acidic protons.

Free radicals are processed by antioxidants that occur naturally in the body or that are found in foods, such as vitamins E and C. Carnosine, too, is a potent natural antioxidant, capable of quenching the negative effects of such free radicals as hydroxyl and superoxide.

Several minerals in their "free"

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Carnosine aids exercise efficiency by promoting the activity of energy-producing enzymes in muscle, such as myosin ATPase, which helps muscle use ATP, the immediate energy source for muscular contraction.

Naveaux Model Marvin Montoya

state, or unbound to blood proteins, can also promote free-radical activity and have been linked to several degenerative diseases in the body—for example iron and copper. Carnosine chelates free minerals, meaning that it locks on to them and prevents the interactions with oxygen that would otherwise generate excess free radicals.

Carnosine aids exercise efficiency by promoting the activity of energy-producing enzymes in muscle, such as myosin ATPase, which helps mus-

cle use ATP, the immediate energy source for muscular contraction.⁴ It plays a role in activating an enzyme involved in glycolysis, or the breakdown of glycogen into glucose for energy purposes,⁵ and in the intramuscular release of calcium ions, which is necessary for muscular contraction.⁶ Caffeine is involved in that process as well, which may be one reason that studies have shown that it increases muscular strength. It also points to a synergistic relationship between caffeine and

athletic and exercise purposes, carnosine was suggested as an efficient anti-aging supplement. One process linked with aging, called glycosylation,⁷ involves having excess sugar deposits in tissues, which leads to aberrations in tissue and organ structure. It's usually related to poor glucose control, as occurs in diabetes or any condition that involves insulin resistance. The substances that accumulate in the body are known collectively as glycosylation end products, or AGEs. Many scientists think that their accumulation leads to the stiffened tissue and manifest signs of human aging.

The AGEs are also involved in degenerative brain disease, with one form, methylglyoxal, accumulating in the brains of those afflicted with Alzheimer's disease. While many consider low-calorie, lowfat vegetarianism a healthful way to eat, many strict vegans, who eat only fruits and vegetables, appear to age more rapidly, at least

carnosine in increasing the strength of muscle contractions.

Before carnosine and beta-alanine became popular for



Carnosine was so-named because it was discovered in meat—which is muscle—back in 1900 by Russian scientists.

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When isolated fibroblasts, or connective-tissue cells, are exposed to carnosine, old cells become rejuvenated. In fact, exposing those cells to carnosine resulted in a 67 percent increase in cellular life span.



Neveux's Model: David Young

externally, than their omnivorous peers. Vegans have been found to have higher levels of AGEs, which may be caused by a combination of higher fructose intake—which promotes AGEs—and lower protein, which leads to lower stores of carnosine.

Carnosine is a natural inhibitor of AGE formation. It appears to prevent the deposition of AGEs in many tissues, including muscle. That's led some to suggest that it's an "anti-aging" nutrient.⁸ Diabetics, who show signs of advanced aging, often have low carnosine stores. When isolated fibroblasts, or connective-tissue cells, are exposed to carnosine, old cells become rejuvenated. In fact, exposing those cells to carnosine resulted in a 67 percent increase in cellular life span. Providing carnosine protects telomeres, the "tails" of cell chromosomes that dictate cell division, from oxidative damage.⁹ That's significant because when telomeres are used up, the cell dies.

Ongoing studies with carnosine show that it may inhibit the buildup of a brain protein called tau, which is elevated in Alzheimer's disease.¹⁰ When applied as eye drops, carnosine may prevent cataracts and other degenerative eye diseases linked to aging and excess oxidation.¹¹ Carnosine levels in the body are known to decline with age. Muscle levels of carnosine drop 63 percent from age 10 to age 70, and some suggest a connection to the loss of muscle with age.

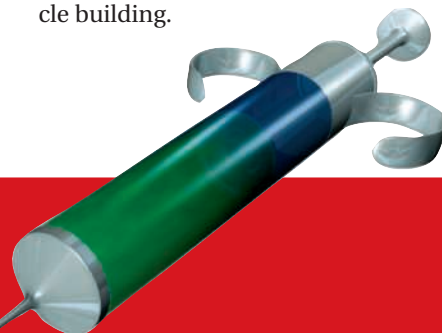
While taking carnosine for purposes of muscle buffering would not work well because of the ever-present carnosinase enzyme in blood, it could still have anti-aging effects. Even when carnosinase degrades carnosine into beta-alanine and histidine, the higher level of amino acids blocks the effects of aldehydes, chemicals involved in the AGEs process.¹²

Carnosine may even help prevent cardiovascular disease through its effects on low-den-

sity-lipoprotein cholesterol.¹³ LDL is the primary cholesterol carrier in the blood and, when oxidized, a primary cause of cardiovascular disease. Its oxidation is often linked to exposure to unbound minerals in the blood, such as iron and copper. Carnosine has been implicated in preventing LDL from binding with oxidants in the blood.¹⁴

Bottom line: Carnosine confers both health and athletic benefits. Ironically, the best supplement for increasing muscle stores of carnosine isn't carnosine itself but instead beta-alanine. Some have already characterized beta-alanine as the "next creatine," including scientist John Wise, Ph.D., who co-authored many of the new studies related to its athletic benefits. Next month I'll look at those studies and their potential impact on strength and muscle building.

One way to overcome the enzyme barrier involves injecting carnosine directly into muscle—but there's an easier way.



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Carnosine is a natural inhibitor of AGE formation. That's led some to suggest that it's an "anti-aging" nutrient.

Editor's note: The patented formula of beta-alanine is available in the new supplement Red Dragon, \$29.95 for 120 capsules. To order, call (800) 447-0008, or visit www.Home-Gym.com.

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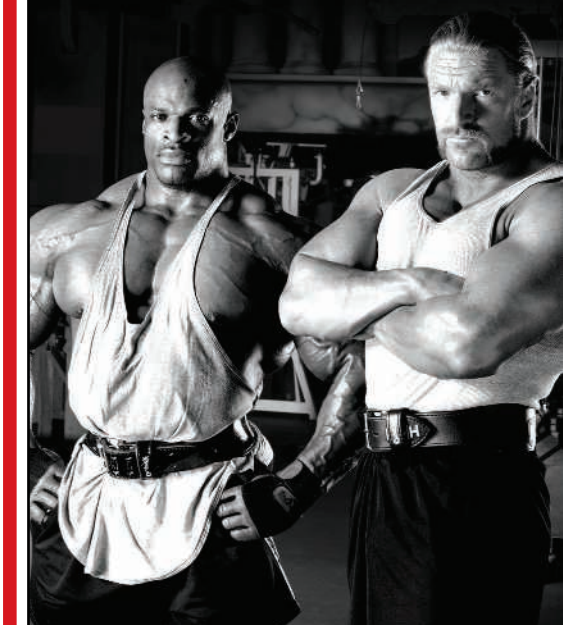
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Carnosine, like caffeine, helps release calcium ions, which can enhance muscular contraction.



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