

Amino Acids & Bodybuilding, All You Need To Know!

Why do so many bodybuilders know so little about amino acids and protein, the differences in their form and the best times to ingest them? With nothing less than optimal muscle growth at stake, time invested in a little research can pay big dividends - both in terms of physical size and dollars saved.

Amino acids are the building blocks of proteins and muscle tissue. All types of physiological processes relating to sport - energy, recovery, muscle / strength gains and fat loss, as well as mood and brain function - are intimately and critically linked to amino acids. It's no wonder amino acids have become major players in athletes' supplementation, especially among bodybuilders.

What are Amino Acids?

The 23 or so amino acids are the molecular building blocks of proteins. According to one accepted classification, 9 are termed indispensable amino acids (IAA, sometimes called essential), meaning that they must be supplied from some food or supplement source; the others, which used to be classified simply as nonessential, are now more correctly termed dispensable amino acids (DAA) or conditionally indispensable, based on the body's ability to synthesize them from other amino acids.

You may not give it much thought when you sink your teeth into a chicken breast (or lentil stew), but the content and balance of amino acids, particularly the ratio of IAA to DAA, is what determines the body and health building value of a protein food or supplement. But that isn't all that matters.

In addition to being influenced by the carbohydrates, fats and total calories associated with it, protein quality is related to the amount of the specific aminos within both the IAA and DAA categories (for example, the amount of glutamine and branched chain amino acids, or BCAAs - leucine, isoleucine and valine). While the amount of IAAs are generally of greater importance, the DAAs are also significant because they're synthesized too slowly to support maximum growth. Even if a source has a perfect amino acid profile for a given individual and lifestyle, another important factor - to what extent these acids are actually delivered to the tissues when needed - must be considered. That, in turn, raises the issues of digestion, absorption, actual bioavailability and the potential value of supplementation.

What is Bioavailability?

Eating quality food is the most common way to get amino acids into the diet, especially high protein foods like lean meats and nonfat dairy products. Even some vegetables and legumes can offer high levels of most amino acids. For serious athletes and those on the run, protein powders and pure free form amino acids provide a convenient and effective means to supplement dietary needs.

Why would people pay relatively large sums of money for only a few grams of pure cheaply? Because of bioavailability. Bioavailability gauges the extent to which an administered substance reaches its site of action or utilization in the body. Bioavailability is thus a measure of the efficiency of delivery - how much of what is ingested is actually used for its intended purpose.

Conceivably, two diets could contain exactly the same amount of particular amino acids (the same amino acid profile) but have significant differences in their absorption. A number of factors affect amino acid bioavailability (see [Factors Affecting Amino Acid Bioavailability](#)). The most reliable way to deliver specific amino acids is to administer the particular amino acids themselves. The most bioavailable source for oral use is powdered free form amino acids.

A singular (unbonded) amino acid can specifically elevate its level in the general circulation within 15 minutes, making it readily available for metabolism at the site where it's needed. Hence, for example, the recommendation to use BCAAs before, during and after training both to prevent central / mental fatigue, as well as to provide a source of energy to help prevent muscle protein catabolism and to speed recuperation.

Applications to Bodybuilding

Muscle tissue will grow in the presence of a number of factors, including exercise, hormones (growth hormone, insulin, testosterone and thyroid) and nutrients. Nutrition science has advanced to the point where athletes who supplement with free form amino acids can get IAAs, high in BCAA content, to the muscles much more effectively.

The key is the window of opportunity that occurs immediately after exercise, when the muscle is especially receptive to nutrients and the blood flow to the exercised muscles remains high. The solution to optimizing recovery and growth in this case could include eating a small meal composed of protein with both simple and complex carbohydrates.

This isn't the current high tech approach, however. For one, if you trained hard, chances are - even if a convenient and light, nutritious meal was readily available - you wouldn't feel like eating. More important, a high protein meal won't put significant levels of amino acids into your bloodstream until a couple of hours after you eat it, especially if blood flow to the gastrointestinal tract has been diminished by a hard training session. The bottom line: Even if you eat the right foods soon after training, the nutrients will arrive at the muscle too late to take full advantage of the window of opportunity.

Directed Amino Acids

Supplement manufacturers recognized the potential value of free-form amino use was limited by their expense and a relative lack of convincing supportive research for a number of years, their popularity has recently increased dramatically. Prepackaged workout and recovery drinks containing hydrolyzed (predigested) proteins and often some free-form amino acids now fill gym refrigerators. Capsules and powdered free-form amino acids, although still somewhat expensive, are likewise being used by increasing numbers of top amateur and professional athletes.

The value of free-form amino acids is first and foremost that they don't require digestion. The term 'free-form' means exactly that: They are free of chemical bonds to other molecules and so move quickly through the stomach and into the small intestine, where they're rapidly absorbed into the bloodstream.

Upon absorption, amino acids are processed by the liver. When you eat a steak, for example, only relatively few amino acids escape the metabolic actions of the liver. Yet the liver can process only so many at one time, and taking a dose of 3-4 grams of rapidly absorbed amino acids exceeds the liver's capacity, resulting in the aminos being directed to the tissues that require them, such as muscle in the case of bodybuilder recovering from training. Thus, the concept of 'directed amino acids'.

While sound in theory, does it work in practice? As early as 1990, the Bulgarian national weightlifting team began trials to determine if free-form amino acids were a boost to muscular growth. The work was so successful that part of the study was replicated on the Colorado Springs Olympic Training Center. Since then, top bodybuilders and powerlifters around the world today - including Mr. Olympia Dorian Yates, and 'Mr. Powerlifting' Ed Coan - have benefited from this new research.

Amino Acids for Energy

Many misconceptions exist about the muscle contraction and the use of energy substrates during heavy during heavy, high-intensity weight training. When you're engaged in a repetitive power workout, a substantial portion of your energy comes from noncarbohydrate sources. When muscle contracts, it uses its stores of adenosine triphosphate (ATP, a substance vital to the energy processes of all living cells) for the first few seconds. The compound used to immediately replenish these stores is creatine phosphate (CP). The recent explosion of creatine supplements in the market attests to its value to hard training bodybuilders and other strength / power athletes.

CP is made from three amino acids: arginine, methionine and glycine. To keep CP and ATP levels high, these amino acids must be elevated in the bloodstream. Traditionally, these proteins have been supplied by foods in the diet. Elevating levels of these amino acids or of CP with conventional foods takes a great deal of time (for digestion) and isn't specific, typically providing levels of fats and carbohydrates that may or may not be desired. The use of free-form amino acids, alone and in combination with creatine supplements, can provide directed source of energy for power and growth.

Amino Acids & Fat Loss

In fat loss, two major processes must occur: 1) the mobilization and circulation of stored fats in the body must increase; and 2) fats must be transported and converted to energy at the powerhouse site of cells, the mitochondria. Several nutrients can assist in the conversion of fat to energy, including lipotropic agents such as choline, inositol and the IAA methionine which, in sufficient quantities, can help improve the transport and metabolism of fat.

Supplementation with complete IAA mixtures, BCAAs and glutamine can also help keep calorie and food volume down while providing targeted support directly to the muscles, liver and immune systems so critical to optimizing body composition.

Reducing Muscle Catabolism

The human body has the innate ability to break down muscle tissue for use as an energy source during heavy exercise. This muscle catabolism can cause muscle soreness, shrinkage of muscle tissue and may even lead to injury.

This enemy to bodybuilders is part of a process known as gluconeogenesis, which means producing or generating glucose from noncarbohydrate sources. The part of this reaction that of importance to bodybuilders is known as the glucose - alanine cycle, in which BCAAs are stripped from the muscle tissue and parts of them are converted to the amino acid alanine, which is transported to the liver and converted into glucose.

If you consume supplemental BCAA's. the body does not have to break down muscle tissue to derive extra energy. A study conducted recently at the School of Human Biology, University of Guelph, Ontario, Canada, confirmed that the use of BCAA's (up to 4 grams) during and after exercise can result in a significant reduction of muscle breakdown during exercise.

In addition to BCAAs, arginine is another amino acid that may benefit bodybuilders. Though it did not live up to its early hype, which touted the amino acid's ability to raise growth hormone level, new data indicate that arginine - in large but safe and affordable doses - may be able to raise GH levels by up to 1,000%.

Free-Form vs. Di & Tripeptides

The form an amino acid takes has been a confusing subject for a number of years, partly because of research that demonstrated superior absorption of purified di- and tripeptides fragments. Di- and tripeptides are simply two and three amino acid molecules bound together, respectively, as opposed to the single molecules of free-form amino acids.

The fact is, pure, powdered free-form amino acids are absorbed from the small intestine into the bloodstream and are available to the tissues very quickly. The problem with pure di- and tripeptides isn't their bioavailability but their bioavailability to consumers. Moreover, hydrolyzed proteins such as whey and lactalbumin are not necessarily good sources of di- and tripeptides. They generally contain very few of these amino acid combinations, and what few they have may get lost in the general wash of longer chain peptides contained in these hydrolysates.

So while pure di- and tripeptides are efficient in their ability to be absorbed into the bloodstream, pure free-form amino acids are equal or superior for bodybuilders and other athletes and more important, are as close as your nearest health food store.

Factors Affecting Amino Acid Bioavailability

How much fat you eat a protein source and the length of time it takes for the digested amino acids to be available for use by the body are determined by a number of factors, which include:

- Cooking - Amino acids are more or less sensitive to heat. For example, arginine is extremely stable and will decompose only if exposed to sustained temperatures about 470 degrees F. Carnitine decomposes at temperatures of 284 F. Cooking, in addition to killing micro-organisms, makes the long spiral polypeptide chains unwind, causing the amino acid to become more exposed when it reaches the digestive system.

- Physical nature of the food, whether solid, liquid, powder or tablet; whether and to what extent chemically predigested and the type and amounts of binders, fillers and other nutritive and non-nutritive materials.
- Status of the digestive system - Genetics, age, overall health and specific diseases and illnesses.
- Metabolism or utilization by the intestine before absorption - such as occurs with glutamine.
- Metabolism or utilization in the liver before transfer to the general circulation - For maximal directed effects, amino acids should be taken on an empty stomach and in a dosage that enables significant quantities to reach the target tissues.

That is it! No magic bullets for mass; instead manipulation of protein and other nutrients offers just enough ammo for gaining size.

Amino Acid Form Comparison & Usage Guide				
Form	Function/Value	Pros	Cons	Recommended Usage
Free-Form	Does not require digestion; small amounts quickly absorbed into bloodstream.	Nutrients absorbed into bloodstream quickly, available to muscle or other tissues; helps prevent muscle catabolism.	Relatively expensive	For example, glutamine: 3-5 grams, 1-5 times per day before or between meals; same for mixture of IAAs.
Hydrolyzed	Predigestion speeds entry into digestive system, but often contains longer chains that must be broken down. Whey and lactalbumin are examples.	Predigestion speeds absorption	Contains longer chains, which must be broken before being absorbed into bloodstream.	For maximum mass . strength gains or during periods of high stress or gastrointestinal problems: 20-30 grams, 1-3 times per day; for optimal health maintenance: 20 grams once per day.
Branched Chain	Aids in the formation of alanine from glucose during exercise as well as glutamine from glucose and alphaketo glutarate.	Can be converted into energy to prevent muscle catabolism.	Relatively expensive form of energy for muscle action.	During hard training: 4-5 grams 2-5 times per day, especially before and after training. Optimal ratio for normal use is 2:1:1 (leucine : isoleucine : valine), although higher leucine content immediately before and after exercise is okay.
Di-Tripeptides	Two or three molecule amino acids that are quickly digested. Depending on conditions, may significantly increase nitrogen retention.	Short chains for moderately fast digestion and absorption.	Cost, availability, taste, osmolality.	Usually found in highest quality hydrolyzed protein supplements (see doses above).

The Amino Acid Guide

There are three types of amino acids; the indispensable amino acids, the conditionally dispensable amino acids, and the dispensable amino acids. Indispensable amino acids, also called essential amino acids, must be supplied to the body from food or supplements. Conditionally dispensable amino acids are based on the body's ability to actually synthesize them from other amino acids. Dispensable amino acids, also called nonessential amino acids, can be synthesized by the body from other amino acids. Here is the amino acid guide and their benefits.

The Indispensable Amino acids

Isoleucine

A branched chain amino acid readily taken up and used for energy by muscle tissue.
Used to prevent muscle wasting in debilitated individuals
Essential in the formation of hemoglobin

Leucine

A branched chain amino acid used as a source of energy
Helps reduce muscle protein breakdown
Modulates uptake of neurotransmitter precursors by the brain as well as the release of enkephalins, which inhibit the passage of pain signals into the nervous system.
Promotes healing of skin and broken bones.

Valine

A branched chain amino acid
 Not processed by the liver; rather actively taken up by muscle
 Influences brain uptake of other neurotransmitter precursors (trptophan, phenylalanine and tryosine).

Histadine

One of the major ultraviolet absorbing compounds in the skin
 Important in the production of red and white blood cells; used in the treatment of anemia
 Used in the treatment of allergic diseases, rheumatoid arthritis and digestive ulcers.

Lysine

Low levels can slow protein synthesis, affecting muscle and connective tissue
 Inhibits viruses; used in the treatment of herpes simplex
 Lysine and Vitamin C together form L-carnitine, a biochemical that enables muscle tissue to use oxygen more efficiently, delaying fatigue
 Aids bone growth by helping form collagen, the fibrous protein that makes up bone, cartilage and other connective tissue.

Methionine

Precursor of cystine and creatine
 May increase antioxidant levels (glutathione) and reduce blood cholesterol levels.
 Helps remove toxic wastes from the liver and assists in the regeneration of liver and kidney tissue

Phenylalanine The major precursor of tyrosine
 Enhances learning, memory, mood and alertness
 Used in the treatment of some types of depression
 Is a major element in the production of collagen
 Suppresses appetite

Threonine

One of the amino detoxifiers
 Helps prevent fatty buildup in the liver
 Important component of collagen
 Generally low in vegetarians

Tryptophan

Precursor of key neurotransmitter serotonin, which exerts a calming effect
 Stimulates the release of growth hormones
 Free form of this amino acid is unavailable in the U.S.
 It is only available in natural food sources

Conditionally Dispensable Amino Acids**Arginine**

Can increase secretion of insulin, glucagon, growth hormones
 Aids in injury rehabilitation, formation of collagen and immune system stimulation.
 Precursor of creatine, gamma amino butric acid (GABA, a neurotransmitter in the brain)
 May increase sperm count and T-lymphocyte response

Cysteine

Detoxifies harmful chemicals in combination with L-aspartic acid and L-citruline
 Helps prevent damage from alcohol and tobacco use
 Stimulates white blood cell activity

Tyrosine

Precursor of the neurotransmitters dopamine, norepinephrine and epinephrine, as well as thyroid and growth hormones and melanin (the pigment responsible for skin and hair color).
 Elevates mood

Dispensable Amino Acids**Alanine**

Major component of connective tissue
Key intermediate in the glucose alanine cycle, which allows muscles and other tissues to derive energy from amino acids
Helps build up the immune system

Aspartic Acid

Helps convert carbohydrates into muscle energy
Builds immune system immunoglobulins and antibodies
Reduces ammonia levels after exercises

Cystine

Contributes to strong connective tissue and tissue antioxidant actions
Aids in healing processes, stimulates white blood cell activity and helps diminish pain from inflammation
Essential for the formation of skin and hair

Glutamic Acid

A major precursor of glutamine, proline, ornithine, arginine, glutathione, and GABA
A potential source of energy
Important in brain metabolism and metabolism of other amino acids.

Glutamine

Most abundant amino acid
Plays a key role in immune system functions
An important source of energy, especially for kidneys and intestines during caloric restrictions.
A brain fuel that is an aid to memory and a stimulant to intelligence and concentration

Glycine

Aids in the manufacture of other amino acids and is a part of the structure of hemoglobin and cytochromes (enzymes involved in energy production)
Has a calming effect and is sometimes used to treat manic depressive and aggressive individuals
Produces glucagon, which mobilizes glycogen
Can inhibit sugar cravings

Ornithine

May help increase growth hormone secretion in high doses
Aids in immune and liver function
Promotes healing

Proline

A major component in the formation of connective tissue and heart muscle
Readily mobilized for muscular energy
Major constituent of collagen

Serine

Important in cells' energy production
Aids memory and nervous system function
Helps build up immune system by producing immuno-globulins and antibodies

Taurine

Aids in the absorption and elimination of fats
May act as a neurotransmitter in some areas of the brain and retina