Amino Acids

The Building Blocks of Life

About a year ago, I developed tennis elbow. For 8 months I could not use my right arm for much of anything without pain and discomfort. Tennis elbow results from overuse of the tendon connecting your forearm to the bone. I tried everything from rest to massage, healing oils and a brace. Around the same time I was learning about collagen, which is primarily made of two amino acids, proline and glycine. Your body makes proline and glycine on its own, but I learned that during illness, injury or through the aging process, your body demands more than what it can make. For mostly cosmetic reasons, I decided to start including collagen powder in my daily diet. I was focused on how it was affecting my skin, but in the meantime I noticed that my elbow was feeling considerably better each day. After only 2 months of taking collagen everyday, the pain went away. To this day, I can use my arm for any activity without discomfort. What had happened inside my body? Collagen is made of proline and glycine. The tendon that was being affected is too.

You are made of many different molecules. The previous article highlighted water-that you are roughly 50-60%. You are also made of amino acids. Amino acids combine to make various types of proteins. You cannot exist without them. Your body can make almost half of what it requires endogenously, but as illustrated, sometimes the body's supplies run out of stock when demand is high. To keep up with demand, it is up to you to supply your body with all 9 essential amino acids, as well as conditional ones depending on what's going on in your life. When you eat protein, your digestive system breaks it down into amino acids. Then your body takes those parts, builds proteins and uses them wherever is most needed.

In this article, you will learn about essential, non-essential and conditional amino acids. What are they and how do they keep your body moving? What are the best dietary sources? How can you know if you are getting enough?

When you think of protein, muscle likely comes to mind. Whereas protein definitely has the job of repairing muscle, nearly every body system requires protein to work efficiently. Amino acids are required for energy metabolism, cellular signaling, for making neurons and neurotransmitters, for your immune system to function, structural integrity, and detoxification. Consider one protein, glutathione. Glutathione is your master intracellular protein involved in fighting free radicals and detoxifying. It is generally made endogenously from glutamate, cysteine and glycine. Your lifestyle can deplete it under conditions of high stress or excessive alcohol use. You have heard about antioxidants such as anthocyanins from dark blue or purple foods like blueberries or elderberries. You also know about EGCG from green tea. Another is beta-carotene from red-orange foods like sweet potatoes. These can possibly provide the body with defense systems and influence cellular pathways. As powerful as you may believe these to be, none compare to glutathione! The body might use plant compounds to maintain cellular activities, but it does not depend on them and they certainly cannot replace glutathione! Not only does glutathione scavenge free radicals, but is integrated into a network of enzymes and recycling systems. It supports detoxification reactions and helps maintain the chemical state of

proteins inside cells. Did you notice that? You need proteins to maintain the chemical state of other proteins! Oh, and did I mention that amino acids are used in the construction of DNA? Ok, so you get it. Amino acids are REALLY important!!!

There are 9 amino acids that your body cannot make, so you must obtain them through food. There are 4 non-essential amino acids and 7 conditional ones.

Functions of Amino Acids: A Quick Glance

Essential	Histidine	Growth; hemoglobin; precursor to histamine
Essential	Isoleucine	Muscle/energy metabolism
Essential	Leucine	Regulates muscle protein synthesis; wound healing
Essential	Valine	Energy production; stem-cell preservation; component of elastin
Essential	Lysine	Protein and collagen synthesis; connective tissue; discussed in relation to cold sores/shingles
Essential	Threonine	Liver lipid metabolism; intestinal lining; collagen and elastin; immune health
Essential	Methionine	Methyl-group metabolism; heavy-metal handling; zinc and selenium metabolism
Essential	Phenylalanine	Precursor to tyrosine; thyroid hormones and melanin; immune functions
Essential	Tryptophan	Precursor to serotonin and melatonin
Non-essential	Alanine	Energy production; blood-sugar regulation; antibody production
Non-essential	Asparagine	Nitrogen transport; neurotransmitter synthesis
Non-essential	Aspartate	Nerve-cell signaling; gluconeogenesis; sex-hormone regulation
Non-essential	Glutamate	Protein and nitrogen metabolism; excitatory/inhibitory neurotransmission
Conditional	Arginine	Urea cycle; nitric oxide; wound healing; immune function
Conditional	Cysteine	Sulfur metabolism; protein structure; immune function; wound healing
Conditional	Glutamine	Nitrogen transport; ATP production; gut, immune, and kidney functions
Conditional	Glycine	Collagen, elastin, keratin, glutathione, creatine, neurotransmitters; growth-hormone synthesis; immune modulation
Conditional	Proline	Collagen, elastin, connective tissue; protein stability during stress
Conditional	Tyrosine	Thyroid hormones; melanin
Conditional	Serine	Phospholipids; neurotransmitters

The chart above highlights what each amino acid is responsible for in the body. How can you keep your body stocked on all these supplies?

Plants and animal-based foods both contain amino acids. The variety you consume, as well as how optimally your digestive system is working affects whether or not these building blocks will make it into your cells. Some plants, such as rice, corn, leafy greens and nuts have only some amino acids, whereas others contain all nine essentials making them a “complete” protein. Foods with all nine include beans, lentils, quinoa, einkorn wheat, chia seeds, hemp seeds, pistachios and pumpkin seeds. Consuming only plant based protein can be risky though. Why? Even foods with all nine essential amino acids do not necessarily have sufficient amounts of these for your body’s demand. Also, all plants are encased in cellulose, or fiber. The fiber is there to stabilize and protect the plant. Plants also have defense compounds called antinutrients. These are phytates, oxalates, tannins, saponins and solanins, among others. The human digestive system does not contain enzymes needed to break down fiber. If your system is already compromised and digestion does not take place smoothly, then the fiber will prevent the amino acids, as well as other nutrients from being exposed to your digestive system, broken down and absorbed into your cells. Additionally, excessive consumption of antinutrients can be toxic to your digestive system and can damage your intestinal lining. Some of these hurdles can be overcome by preparation and cooking methods, such as soaking and sprouting. But even going through these extra steps may not be optimal for your body’s needs. How can you know?

You should not feel digestion

If you experience any abdominal discomfort, bloating, gas, constipation, heartburn or excessive belching, then digestion is compromised. And if you experience any of these on a regular basis, you are likely not absorbing the amino acids in your food. If you need a laxative to have a bowel movement, you are not absorbing the nutrients. Paying attention to how digestion is working is one way to monitor your body. In other ways, your body lets you know when it's low on stock. Have you been feeling tired, run down, or unmotivated? Is your hair thinning, skin sagging, joints or muscles aching or experiencing swelling (edema)? Do you get sick frequently, find that wounds heal slowly or can't seem to readily remember things? These can all be signs of protein deficiency. And the problem may not necessarily be that you're not eating enough, but rather that the nutrients are not being digested and absorbed.

Animal based foods may be optimal

What about animal based foods, fish and shellfish? Including animal products, such as muscle meat, soft tendon, skin and bone broth, as well as eggs, fish and shellfish in your diet ensures you are giving your body the materials it needs for optimal protein synthesis. Why? These foods have all amino acids, even the conditional and non-essential ones and in adequate proportions. Whatever your body demands, you will be keeping it stocked. Animal based foods also are bioavailable. Bioavailability is the extent to which a nutrient is absorbed and becomes available for the body to use. They contain no antinutrients or fiber and thus present no challenge to your

digestive system on their own. What if you have found that you cannot digest these? In order to break down protein, your body makes enzymes and digestive juices as well as hydrochloric acid. If your pancreas is functioning poorly, then it may fail to excrete digestive juices. Hydrochloric acid requires chloride for synthesis, which is obtained through salt. If you are eating a low sodium diet, then you will likely be low in hydrochloric acid. A poor diet can contribute to problems with your pancreas and HCL production. Both of these are correlated with insulin resistance, a condition that results from consuming a diet high in carbohydrates and processed oils.

As mentioned earlier, when you consume protein, your body breaks it down into individual amino acids and then uses them where needed. If even one amino acid is missing to make a certain protein, then protein synthesis will halt. If this keeps happening, body systems begin to fail. One amino acid cannot act as a substitute for another. They each have their own role in your body. So please ensure that your diet contains sufficient and varied amino acids and that digestion and absorption is taking place smoothly.

What Does Your Body Need?

1) Foods that include all essential amino acids, plus others depending on your age or body's needs
2) Bioavailable food options to ensure amino acids make it into your cells
3) Sufficient proportions of amino acids

Food examples

All essential amino acids/ bioavailable/ proper proportions:
Animal products, fish, shellfish

All essential amino acids/ not always bioavailable/ not always sufficient proportions:
Legumes, wheat, quinoa, chia seeds, hemp seeds, spirulina, pumpkin seeds, pistachios

Some amino acids/ not always bioavailable:
Most nuts/seeds, vegetables, grains

Cellular signaling: necessary for collagen synthesis

As you age, cellular signaling and fibroblast activity slows down. Older tissue also slows anabolic signaling. You may be giving your body all the raw materials it needs, but protein synthesis is slow and inefficient. What should you do? What activates cellular signaling? The answer is mechanical loading, a.k.a. weight bearing and resistance exercise. If you don't already, including an exercise routine in your life can work wonders at keeping your body functioning optimally. Other factors in an overall unhealthy life can also contribute to poor

signaling. Nutrient deficiencies in addition to amino acids, oxidative stress, mitochondrial dysfunction, insufficient oxygen, insulin resistance, chronic inflammation, poor circulation, high blood pressure, obesity, and chronically elevated cortisol are all contributing factors. Does it seem impossible to avoid these conditions? On the contrary. You can be in control by making good choices each day in all areas of life. There is no substitute for this simple truth. No superfood, supplement, drug, workout routine, procedure or surgery can give you what you need to maintain your body. By eating nutrient dense, bioavailable food, moving your body regularly, ensuring quality sleep, learning to manage stress and making time for self-care and recuperation are all measures within your reach. If you are ready for change, but need some motivation and accountability for a time, reach out to a health coach for help. As a coach, I believe you are more than capable of realizing and reaching your potential!

A Look Inside Body Systems

Musculoskeletal	Muscles, tendons, joints, cartilage, bones, and collagen depend on leucine, glycine, and proline
Nervous	Amino acids support neuron structure, membranes, and enzymes. Glutamate/GABA, tryptophan, and tyrosine
Immune	Support immune-cell growth, antibodies, cytokines, and pathogen response; glutamine, arginine, and tryptophan
Digestive and metabolic	Intestinal-lining renewal, enzymes, liver metabolism, ammonia disposal, and bile synthesis; gut microbes can ferment amino acids.
Cardiovascular	Heart-muscle and blood-vessel proteins; arginine and nitric oxide; glycine and proline in vessel-wall connective tissue.
Endocrine	Amino acids are involved in insulin, growth hormone, glucagon, and thyroid hormones.
Renal and urinary	Glutamine is used by the kidneys to generate ammonia and help maintain acid-base balance.
Integumentary	Keratin forms hair and nails; collagen provides skin strength; cysteine contributes to keratin structure.
Hematologic	Hemoglobin and heme synthesis; glutamine supports blood-cell production and metabolism.
Reproductive	Reproductive tissue, sperm and egg development, peptide hormones, and signaling molecules.
Respiratory	Collagen and elastin help maintain lung structure; amino-acid metabolism supports respiratory muscles.
Visual	Retinal proteins and taurine are required for normal eye function.
Skeletal mineralization	The bone matrix is formed by collagen.
DNA synthesis	Glycine, glutamine, aspartate, and methionine
ATP	Glutamate is linked to ATP production.

What About Animal Welfare?

If you believe animals should not be mistreated, that concern matters. Some people distinguish between cruelty and the use of animals for food, clothing, or shelter. Animal-based foods are available from farmers who have treated their livestock with kindness and decency. Your high standards for the animal products you choose correlates with its nutrient density. Animals that have been raised in their natural environment, on their natural diet and in stress free conditions have healthier tissues and organs that are now going into your own tissues and organs.

Another look at Collagen

Collagen is the body's most abundant protein and is rich in glycine, proline, and hydroxyproline. Think of it as the "glue" that holds you together. It provides structural support in skin, bones, and blood-vessel walls. It makes up 75-80% of your skin and 30-35% of your bones. Collagen makes up 90% of the bone matrix that serves as its structural support. Collagen can also make up to 50% of blood vessel wall structure, depending on the type of vessel. Vitamin C, iron and copper are required for collagen synthesis. Collagen production and turnover change with age. Supplementing with collagen peptides has been shown to be effective with regular consumption.

What is Creatine?

Creatine is synthesized from arginine, glycine, and methionine. It participates in the phosphocreatine system, which helps rapidly buffer energy demand, especially in muscle. Supplements may be useful in some contexts, but they do not replace an adequate overall diet.

What about cancer, heart disease and studies correlating red meat consumption?

Studies are biased and cannot always be taken at face value. Cancer cells feed on many different things, but glucose, not red meat, is preferred. Consuming red meat is not correlated with heart disease. Cholesterol, as related to heart disease is gravely misunderstood. Heart disease results from damaged vessel walls and large amounts of low density lipoproteins, particularly with an apoB structure that has been circulating too long in the bloodstream, making them more likely to get trapped in vessel walls and the contents they carry to become oxidized. Your immune system's response to the oxidation is what leads to plaque buildup.

Do you know what can help strengthen vessel walls? Collagen! Do you know how to avoid apoB LDL? Stay away from processed foods. Excessive carbohydrates create the need for your liver to make excessive vLDL and processed oils are subject to oxidation

due to their unstable molecular structure.

If you read a study that questions eating animal products, especially red meat, consider who funded the study and what their objective is. Also, ask yourself if all variables and results were considered and included in the study. For example, a study may be conducted on red meat, using a hamburger. What was the quality of the meat? Did the subjects also consume a high carb, processed bun with their burger? What about condiments, including mayonnaise made with inflammatory seed oils? And finally, were there any accompaniments such as chips or fries? Remember that a study does not have to include all these details to be published and create a biased leaning.

Next in What Are You Made Of?: Lipids