

One doesn't have to look far to find that the world is brimming with strategies and solutions for health and wellness. Diets, workout plans, chic exercise gadgets, nifty phone apps all promise improved health. People count calories, cut carbs, switch to quinoa, swap wine for spritzers, or whatever the current fad is in the current time in human health history. Yet many are armed with so little knowledge of what the body truly needs. What is taught in high schools about nutrition and daily allowances is archaic, outdated, cookie cutter information that doesn't properly fit an individual. Unfortunately common education has not progressed with scientific discoveries and common sense and we are left with a population of self-diagnostic diet dummies!

Many fad diets keep protein as a central focal point in their eating plans: Keto, Paleo, South Beach, Atkins, etc. Most people learn about these diets through the internet and after hearing the dazzling success stories of other people losing weight and feeling great, decide to begin these diets, too. Very few people understand what protein is or how it affects the body's systems. In most part, it is the absence of education and information that limits the average person's understanding of what the body needs and how to properly fuel it. The health education available in this country is tainted by big-corporations, the pharmaceutical companies, and the agenda of the FDA. The information supplied to consumers has not been very helpful in making healthy choices.

Even though most people are in the dark about the importance of protein, much has been learned over the years. Not just about proteins themselves but about the pieces of proteins, Amino acids. Beneath the surface of diets and food fads, the value of proteins, really amino acids, is waiting to be learned.

History of American Nutrition

For over 100 years the United States government has been attempting to educate its people on dietary recommendations. The first suggestions appeared in 1894 in a Farmer's Bulletin. This dietary guideline was intended for males only and suggested the inclusion of protein, carbohydrates, fats, and mineral matter for health. In this bulletin milk is touted as the perfect food. Bread and meat are considered the most healthy combination of food that supply all the nutrients needed by the body. The bones and fat on a cut of meat are considered refuse and have should be entirely removed before consuming the meat (Atwater). While some of its suggestions seems abstract, the bulletin does explain the food groups as they function in the body in a more comprehensive way than modern information addresses. Protein is described as the nitrogenous material that builds muscle, tendon, and all bodily fluids (Atwater). So at least the people of 1894 were given a little understanding of what protein does in the body.

About 20 years later in 1916 the first food guide from the USDA was written by Caroline Hunt called *Food for Young Children*. In it she broke down diet into five main categories: meats, cereals, veg and fruit, fats, and sugars (Riley's). Hunt also claims that milk is the most perfect form of food for children and believes this to be the most perfect form of protein. She does, however say that children should eat eggs with regularity. Her article is focused on food preparation and recipes with little mention of how protein is working within a child's body (Hunt).

In the 1920's and 30s, the USDA devised food plans for different levels of incomes to help people shop for food during the Depression. So diet was varied by

good or bad fortune. Those who were fortunate were recommended to eat meat, fish, eggs, milk. Those that were severely struggling were advised to eat primarily grains and cereals. The suggestions made by the government at that time essentially eliminated protein from the poorer communities (Stiebeling). Yes, they were desperate times, and indeed the response was a desperate measure.

By the 1940's a system was developed to categorize the nutrients and calories that were recommended and this was revised in wartime to help with rationing and limited supplies. The Recommended Daily Allowance reflected the needs of war-time, certainly not a picture of health. This basic recommended daily allowance has essentially remained the same for the past 80 years.

During the 1950s'-70's, the format changed into four categories: meat, milk, fruit/veg, and grains. The focus at this time was in getting sufficient nutrition. However by the 1990's, it was clear that the overconsumption of unhealthy foods such as saturated fats, sodium, and sugar were becoming an ever increasing problem. This prompted the creation of The Food Guide Pyramid in 1992. In 2005, in response to the ever increasing issue of chronic disease and obesity, the pyramid was adjusted to promote moderation and physical exercise (Riley).

On the Food Pyramid, protein was merely a section that had chicken, fish, beef and eggs. The average person just understood protein as a different food category that should be eaten in some sort of portion control. People on average thought of protein as a palm-sized piece of chicken or 6 oz of a steak. The role of protein in the diet, what protein actually does, was not mentioned. People were told to eat certain types of food with no real explanation as to why other than suggestions at healthy

behavior. This lack of true education does not empower people to make wise choices for their health. People will ultimately eat what tastes good to them, without caring about politically produced portions.

While the government has tried to create standards and models for healthy eating, the education to make these choices is lacking and the quality of standard food is severely lacking. These models present “ideal” eating patterns that include whole foods but ignore the actual eating patterns of the public that primarily include processed foods. The government’s ideal patterns are out of touch with the real eating habits of the American people that are guided by massive corporations. These Food Pyramids ignore the fast food, processed, preserved foods that are driving the nation and by ignoring them do not address the food crisis in this country.

The last adjustment to America’s food guide happened in 2011 where the pyramid was replaced with a plate. The five groups remain the same but the emphasis was on “personalized food choices” (Riley’s). And personalization has certainly become the norm in our society but not, perhaps in the right way. Ideally diets would be personalized based on someone’s blood type, metabolic type, glandular type, constitutional type, elemental type, where they live, what season it is, what weaknesses they need to strengthen, and even what emotional temperament they have. Yet the educational system in the United States does not teach this or even encourage such personalization of diet. Instead, people self-diagnose their needs primarily based on how they want to look or what is currently popular. Then a “personalized” diet is chosen based on preference (want to eat bacon or drink smoothies?) and promise (want to build muscle or loose your spare tire?). What results

is that most people are motivated by vanity, popular opinion, and misplaced self-confidence and join one of the dozens of current diets.

Even though the government has tidily organized food into five main categories, even then most people don't fully understand them very well. Food and health wisdom are learned from current fads or blogs on the internet. They've heard about carbs, fats, proteins: carbs are for cutting out, fats are for avoiding, and protein is to build muscle. But still, most people don't even know what these things are for or what they do. Of all of the categories, the most focused on and least understood could arguably be protein. Most people do not know much about what to eat and why.

What is Protein

Have you ever paused to consider your protein? Not just the protein you eat but the protein that you are? Few people probably even realize that their own bodies are composed of protein, that they themselves *are* protein. But what really is protein? Some may have heard that “proteins are the building blocks of life.” In part, this is true. But in fact, proteins are made out of chains called peptides and these peptide chains are made of linked amino acids. So more accurately, amino acids are the building blocks of life.

The word “protein” comes from the Greek for *protos* which means “first”. This is a fitting name since proteins are the basic foundation for all life. Peptide comes from *peptos* meaning “cooked” which is a clever way of referring to the process of breaking down or digesting proteins into peptide. In essence, peptides are digested (broken down) proteins (Braverman). The etymology of amino acids, however, is less clear to the layman. Every amino acid is made of an amine, an organic compound derived from ammonia (“amino” also means ammonia) joined together with an organic acid (Foundations). So the unglamorous name of these true building blocks is ammoniated acids.

Amino acids, or AAs, are unsung true heroes in our body’s chemistry and makeup. However, little to no education has been given to the average person or even most health professionals about their roles and importance throughout health history. Amino acids comprise 3/4 of the body’s dry weight (if water content is excluded) (Chaitow). Interesting, isn’t it, that most people know about our liquid makeup: that we

are nearly 80% water, but many may have no idea what our dry matter consists of or even what an amino acid is.

Remarkably there are only 26 amino acids needed by the body to create the over 50,000 different types of proteins present in the human body. These proteins create our many tissues: skin, hair, nails, organs, blood cells, bones, the list goes on! Not only do amino acids create those dense proteins, they also create our neurotransmitters and thereby create the conditions of mood, mental acuity, emotions, and influence how nerve signals are communicated in the brain (Chaitow). When you eat a piece of chicken, the body breaks down the protein of the meat in the digestive track back down into amino acids and then rearranges the AAs into whatever specific substance the body needs (Braverman). Additionally, amino acids are what power all movement within the body based on their chemical structure.

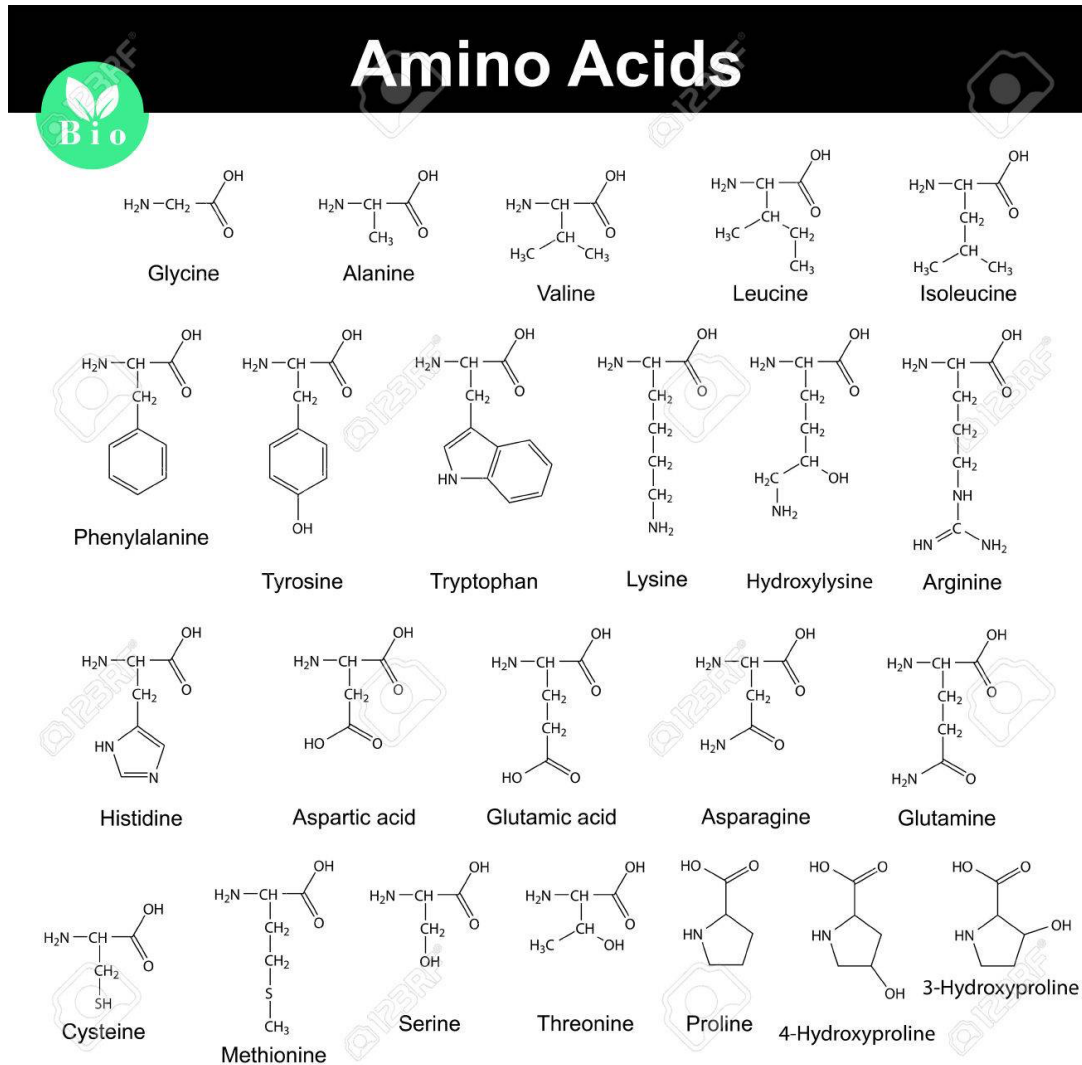
Even more than that, amino acids are involved in nearly every system of the body. They influence in vitamin absorption. They make hormones that signal different glands and body systems to work. They build these glands and help them grow. They influence our moods and behavior. They live in all of our mucous membranes. They grow our hair. They keep cells healthy. They are the material that makes cells. They are the material that forms our DNA. Truly we have overlooked some of the truly incredible and necessary pieces of what we are made.

Amino Acid Anatomy

The physical structure of Amino Acids is rather simple in concept. All proteins are made of hydrogen, oxygen, carbon and nitrogen. Nitrogen is what gives a protein its ability to heal and repair tissues. (Remember the 1894 bulletin mentioned nitrogen's tissue building ability). Amino Acids, the building blocks of all of our proteins, are made of an acid group and an amine group. The acid group of molecules contains the hydrogen, oxygen, and carbon (Braverman). More specifically they contain one hydrogen, two oxygen, and one carbon: HOOC. The conjoining amine group is where the nitrogen is incorporated, one nitrogen atom and two hydrogen atoms or NH₂. The amine and acid group are joined together by what is called a methylene group that consists of one carbon and two hydrogen atoms or CH₂. If there is only one methylene group connecting the amine and acid, these are an alpha group. If two methylene groups connect the amine and acid it is referred to as a beta group, and so on. The basic amino acids in the human body are alpha amino acids. So our basic structure for an alpha amino acid is: acid group-methylene group-amine group. Or HOOC-CH₂-NH₂. This basic structure happens to be the amino acid glycine.

It is the connecting group in the middle, the methylene group, that is the one of most interest. CH₂ can also be visualized as H-C-H. Envision one of the hydrogen atoms as a "side chain" that can be replaced with a variety of combinations to create different amino acids. "It's this position which is modified to create a short library of 20 alpha amino acid compounds which are used to produce nearly all the proteins and enzymes that drive the chemistry of life" (Foundations). That's pretty phenomenal.

By observing the chart below, one can see how the central methylene group changes its side chain to produce the various amino acids (please note not all amino acids are represented here).



The side chains have some similarities between each other and therefore amino acids can be categorized into different types. This includes aromatic AAs, sulfur AAs, glutamate AAs and branched-chain AAs. These different side chains influence how the amino acids work in the body and how the body can work, including how things move!

Amino acids with their amine-methaline-acid groups form a line or conformation that naturally has a balance of the molecule's electrical charges. However, when these charges are altered, be it by neurotransmitters or hormones the line will bend and twist. For example, if a conformation has a negative charge at each end, the negative charges will naturally repel and the conformation will extend into a line. When a signal comes along, perhaps something with a very strong positive charge, one end of the confirmation will attract to and bind to the positive charge and the opposite end will similarly twist around to also bind to the strong positive charge thus turning the line into a circle. While the shapes of amino acids are more complex than circles and lines, this concept is how movement happens in the body.

“Changing confirmations generates movement and the movement is harnessed to do work providing for such functions as digestion, respiration, and muscle contraction. When the signal detaches, the protein returns to its preferred extended confirmation. This is how signal-generated protein movements provide for life” (Lipton).

These little molecules do so much more than build us , they move us, too. Every muscle contraction, peristalsis, every movement we make is by the movement of our amino acids. But barely anyone seems to know a thing about them. Their value has been so overlooked.

Amino acids are categorized as essential and non-essential. Some are able to be synthesized by the body generally in the liver and these are non-essential. Others have to be provided by the diet. These are called essential amino acids, being that it is essential that we eat them. So providing the body with the right nutrition, the right source for amino acids, is imperative for health and functioning.

There are 20 commonly accepted amino acids. But lists of amino acids can generally have 26 or even more on them. They are separated into 8-10 essential and the rest as non-essential. This variance in essential amino acids is based on the argument that some amino acids are primarily needed at certain points in development and are therefore not always essential. The 8 basic essential amino acids are: isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Many scientists also add histidine and arginine on the list of essential AAs. The remaining non-essential AAs are alanine, asparagine, aspartic acid, carnitine, cysteine, GABA, glutamic acid, glutamine, glycine, ornithine, proline, serine, taurine, theonine, and tyrosine.

Amino Acid Discoveries

Amino acids have been known to science for over 200 years. Some of their history is as follows. The first AA was discovered in 1806 by French chemists Vaquelin and Robiquet. They found crystals forming in an extraction of asparagus and identified an “unknown substance” that was Asparagine, yet it was not named as such for another twenty years (Chemtology). The following year, 1806 the same two scientists discovered the AA Leucine.

The discovery of aspartic acid happened in 1827. French chemist Auguste-Arthur Pilson was busy disproving the work of another colleague who believed he had discovered a new element from the root of the marshmallow plant. Pilson, however, proved that the substance was in fact asparagine. After disproving his colleague’s “novel” discovery, he did what most 19th century chemists at the time would do and boiled the sample with lead hydroxide. He found that the compound appeared and tasted (!!) different. He was going to call this new compound “l’acide asparagique” being that it was an acid from asparagine but he was concerned that the name would imply that it was a naturally occurring compound from asparagine, when in fact he had created it in his lab. So Pilson named his discovery “l’acide asparartique” to point out that the substance was artificial. By 1842 the additional art was dropped and the name became “l’acide aspartique” or aspartic acid. But it would take another twenty years for scientists to discover that Pilson’s discovery was not a synthetic lab result but was in fact a real protein that occurs in nature (Chemtyology).

It is impressive to think of what scientists were able to achieve in the 1800s with the limited equipment that they had. Sometimes discoveries were made by accident or

were only able to be seen in certain ways. By 1865, only four amino acids-leucine, glycine, tyrosine, and serine- had been identified through protein hydrolysis, or by enzymatic action on a protein (breaking down a protein). Even though it is now known that all proteins break down into amino acids only these four were able to be identified in this way at this time. A German scientist named Karl Heinrich Ritthausen was able to add two more to this list.

Ritthausen first studied chemistry at Leipzig and Bonn and there gained inspiration to pursue a career in agricultural chemistry. Ritthausen earned his doctorate in chemistry 1853. From 1854-56 he was director of the scientific department of the Agricultural Experiment Station at Mockern, near Leipzig. By 1857 he was a professor of chemistry and physics at the Royal Agricultural Academy at Waldau and from here was professor at many other prestigious institutions including the University of Königsberg (now Kaliningrad) until his retirement in Berlin in 1903 (encyclopedia).

In the earlier part of his career, Ritthausen turned his attention to the study of plant proteins. In 1862 he began studying the proteins of wheat and over the next five years he studied legumes and oilseeds as well. His work led him to discover two amino acids through protein hydrolysis. At the time, this was a very difficult undertaking. In 1866 by working with wheat gluten that was soluble in an alcohol-water mixture he was able to use sulfuric acid to break it down into crystals that had not been known before (encyclopedia). These crystals were named glutamic acid from the latin *gluten* meaning to glue (chemtology). Soon he and his colleagues were able to identify this amino acid present in many other proteins.

Two years later, Ritthausen was able to use protein hydrolysis to find another amino acid from almonds. This was identified as aspartic acid, the same as accidentally discovered by Pilson nearly 20 years prior. Although this amino acid was well known by Ritthausen's time, he was able to prove its presence in proteins.

It was later discovered that these two amino acids: glutamic acid and aspartic acid are nearly entirely responsible for the acidic qualities of most all proteins. This discovery by Emil Fischer also showed that nearly every protein in existence contains these two important amino acids. These discoveries were important contributions to the knowledge of amino acids as they work in nature.

At the time, protein hydrolysis was successful at isolating amino acids but it also would break down the amine part of the protein. In 1873 scientist Hlasiwetz and Haberman published a paper describing how when casein (the main protein in milk) is broken down with hydrolysis it produces glutamic acid, aspartic acid, leucine, tyrosine, and ammonia. These scientists already knew that when ammonia was released from asparagine aspartic acid is formed and thus hypothesized that glutamic acid could be formed from a precursor as well. They referred to it as "glutaminsäure" which they referred to simply as glutamin. However it wasn't until 1932 that chemists were finally able to discover that both asparagine and glutamine were present as amino acids in peptide chains before they were broken down further into their acid constituents (Chemology).

Another notable scientist in the discovery of amino acids was Albrecht Kossel. A Doctor of Medicine in 1878 at the age of 25, Kossel had an astounding career. By 30 he was Director of the Chemical Division of the Institute of Physiology in Berlin, and

was later given the title of Extraordinary Professor in the Medical Faculty. He became Director of the Institute of Physiology at Marburg and became the Chairman over the Seventh International Congress of Physiology in Heidelberg. The next year in 1908 was protector of the University. Kossel was an honorary doctor at the Universities of Cambridge, Dublin, Ghent, Gfiefswald, St. Andrews, and Edinburgh and was a member of the Royal Swedish Academy of Sciences. In 1910 he won the Nobel Prize in Physiology/Medicine. Truly a remarkable career!

Kossel's work focused on the chemistry of tissues and cells. However his experience as a professor at the universities extended his expertise into general physiology, which at the time in Germany physiology was combined with chemistry. In the 1870s he focused on the cell but by the 1890s he focused his attention on the study of proteins. In 1896 he discovered histidine. From this work he was able to discover the method of separating hexane bases. Kossel's work was paramount in creating the backbone to what we understand about DNA today.

Indeed the discovery of many amino acids is full of accidents, assumptions, and sometimes pure luck! But by 1935 all common amino acids had been discovered (Bojarska). By this time, their value in nutrition was beginning to be understood by the scientific community. The importance of essential amino acids was particularly gaining value. Scientists were learning things about them such as how methionine is needed in cell metabolism, tissue growth, detoxification, and for the body to absorb selenium and zinc; valine was discovered to stimulate muscle growth and energy production; histidine was found to maintain the myelin sheath, prevent obesity and regulate sleep/wake cycles; threonine was found to be the constituent of collagen and is used in

immune function and sleep regulation. While the importance of these building blocks were being discovered, it was not communicated clearly to the public and thus knowledge of their value, let alone their existence, has primarily been minimal. Therefore their role in diet has been essentially overlooked.

To this day, dietary guidelines do not mention the role of amino acids. Other than protein recommendations, these powerful building blocks are left in the dark. Therefore the responsibility falls on the individual to educate themselves about natural healthy foods and to understand what these foods are doing for them.

Back to the American Plate

The solution to providing the body with the amino acids necessary for the plethora of jobs they perform does not necessarily equal eating large quantities of meat. The American way is often lined with excess. In the United States, obesity is an outward sign of our overconsumption and overindulgence. Diabetes is one of the most common diseases in the country and it is a self-inflicted disease.

Diabetes is a disease where the pancreas no longer is able to produce enough insulin in the body. It is primarily understood that an overconsumption of sugar causes this ultimate sugar issue. However, there is another way in which the pancreas will begin to suffer and not function and cause diabetes: too much meat.

Overconsumption of meat overtaxes the pancreas and stresses it to the point of shutting down.

“For a variety of reasons the pancreas may be overstimulated, and one such reason is the very fact of excessive protein intake. The proteolytic enzyme production capacity of the pancreas can, like any other function, become impaired through over-use. This is especially true in an organ like the pancreas with multi-purpose functions, all of which may be overtaxed simultaneously... This is followed by reduced enzyme activity and finally insulin production is affected.” (Chaitow 21).

So essentially by over consuming protein, the body is unable to break down and use the protein. If the body cannot break down protein, then it cannot access the amino acids that are so necessary for life and function. Indeed balance is the key to health and longevity. An excessive American reaction to protein ultimately puts the body in a state of malnourishment and leads to other diseases.

The goal of digestion is to break things down into small enough pieces so that they can be utilized by the body. If the body is unable to break things down through the catabolic process of metabolism, then digestion is not succeeded. If particles are

not small enough to enter into the body, then the body lacks that nutrient and is in a state of deficiency. It is extremely possible and these days very probably that obese or overweight people are extremely malnourished. Not only are the foods they are eating lacking nutrition, but their bodies are losing the ability to extract what nutrition there may be.

Until education shifts, many things about American diet will remain the same. The government and education system are not reliable sources of information for the all-important choices of what foods we need. It is up to the individual to pursue the correct information and learn natural solutions to proper eating. The goal of proper nutrition is health and lack of dis-ease. Ultimately your health is in your hands or, rather, on your own plate!

A Peek at the Primordial World

Beyond their role in the human body, scientists believe amino acids are just the building blocks of human life but of all life. In 1953 two scientists set out to prove this. Stanley Miller and Harold Urey performed an experiment to recreate the planet as it was 3 billion years ago with the intention to create life (Foundations). They combined ammonia, hydrogen, methane, and water vapor in a flask and then added electrical sparks. In this flask new molecules were born and of them they were able to identify 11 standard amino acids.

From this discovery they suggested that the first organisms on this planet must have had an environment similar to the conditions of their flask. And from this primordial soup single-celled organisms evolved. They posited that as organisms developed they depleted the available organic material and that those organisms that survived were able to synthesize their own nutrients from the available elements. We find this is true today since most organic compounds come from biological organisms that break down and therefore feed other organisms. They concluded that this enzymatic action is what produces amino acids (Gutierrez).

The question then remains: “were amino acids the first biological particle to participate in life on earth?” (Foundations). When amino acids join together, they can produce innumerable combinations that can create countless things. Perhaps Miller and Urey were onto something. Perhaps amino acids are indeed the building blocks of all life on this planet. Though we have only been aware of them in recent history, their existence predates human cognition. These same incredible compounds not only built the planet, they build our bodies and they move our world.

Alanine

-Blood sugar support -Diabetes helper -Energy creator

-Thymus growth -Immune system support

Alanine is a non essential amino acid consisting of a glycine cornerstone with a simple side chain. It is made from the conversion of pyruvate, a common compound in carbohydrate metabolism, or by the breakdown of DNA and the dipeptides carnosine and anserine (Braerman 233). Alanine is known for its ability to help balance glucose levels in the body when the body is in need of fuel. It can both help aid in the metabolism of glucose and also be easily turned into glucose to aid the body's sugar levels. This helps to prevent imbalance in the body.

Alanine is mostly found in the muscles of the body but also slightly in the blood, liver, kidney, and brain. This amino acid is used to help the muscle circulate energy throughout the body. During physical exercise, the proteins in muscle can quickly degrade and build up creating toxins in the body. Alanine acts to remove nitrogen from the muscle and transports it to the liver for removal thus avoiding any toxic build up in tissues. In the liver, alanine is easily converted into glucose for the body's use. This assists the body in balancing sugar levels in instances of hypoglycemia and diabetes alike (Braverman, 233).

There is a relationship between insulin and alanine. When insulin rises, alanine drops and deficiencies of alanine have been found in patients with hypoglycemia. However when given to a patient, alanine is able to stimulate blood sugar to rise by instigating the release of glucagon, the hormone that releases glucose into the body.

This can be of great use for someone suffering from low blood sugar especially when they are experiencing rapid heartbeat and anxiety (Braverman 236).

While Alanine is beneficial to those with hypoglycemia, it also plays a role in diabetes. Alanine prevents ketosis in the body by having a direct effect on the liver. When a diabetic's low insulin level causes their blood sugar to increase, they can go into a state of keto that is a problem for the diabetic. Alanine increases in tandem to the increased blood sugar similarly to how it parallels a hypoglycemic's sugar levels as well. This elevation of sugar in a diabetic can cause ketoacidosis which can lead to lack of consciousness and coma (Braverman 237) but alanine can decrease the severity of the ketosis. Studies are still investigating the link between alanine and diabetes.

In addition to being found in muscle tissue, Alanine is also found in prostate fluid, and thus plays a role in prostate health. According to Dr. Billie Sahley and Dr Katherine Birkner, a study of 45 men with symptoms of benign prostatic hypertrophy (BPH) who were put on alanine supplementation for three months had reduced symptoms of BPH (25). This suggests that alanine can play a role in maintaining a healthy prostate.

An important part of the immune system, alanine participates in different roles. It helps to produce antibodies and also stimulate the production of lymphocytes. Alanine is also necessary for thymus growth (Braverman 237). Thus immune-deficient conditions can be attributed to low alanine in the body and also auto-immune conditions. A naturopath can incur the connection between immunity, the thymus, the sense of self, and emotion of self love all facilitated by this amino acid.

Another factor alanine can influence is cholesterol. When used in combination with arginine and glycine, these amino acids have been shown to decrease cholesterol by 50% in studies with rats (Chaitow 81). A naturopathic perspective, however, would also be interested in why there is an elevated cholesterol level in the body and to determine what the body is trying to heal from with the cholesterol rather than to just reduce it.

According to Dr. Eric Braverman and his clinical studies, severe alanine deficiencies do not usually occur since alanine is often found in combination or in conjunction with other amino acids (238). Generally low levels of alanine are seen with low levels of glycine, taurine, or the Branched Chain Amino Acids (Sahley, 25). So it is difficult to pinpoint or isolate alanine deficiency for a root cause of an illness. However, some symptoms that could point towards low levels of alanine are hypoglycemia, elevated insulin and glucagon levels, muscle wasting, and low growth hormone level.

There has been no noted discovery on alanine toxicity so there is no caution to over consuming it. Capsules or tablets of alanine are available but often times the best way to consume nutrients is through food. Some of the best food sources for alanine are yeast, spirulina, seaweed, sesame seeds, soy, fish, beef, gelatins, wheat germ, turkey, duck, cottage cheese and sausage (Sahley, 25).

Arginine

-Urea System Support -HGH releasor -Sperm/Erection assistant

-Vasodilator -Muscle Strengtheners -Cancer helper

Arginine is an essential amino acid that is particularly needed during periods of growth. Later in life the body is able to manufacture it on its own, but at the beginning of life it is considered essential. But of course every individual is an individualized being with different needs so while some may be able to synthesize this amino acid in their body, some may still need assistance. This can be called a “contingent” nutrient since some people may still need to obtain arginine through the diet at later stages of life (Chaitow 37). States of stress, infection, trauma, or disease can inhibit the body’s ability to create arginine at a sufficient pace and at these times this amino acid becomes essential to the system (Braverman 147).

Arginine is synthesized in the liver and secreted by the anterior pituitary gland. It performs some very important functions. It is involved in many actions in the body including releasing growth hormone from the pituitary gland, increases sperm count, fights infect, builds muscle, and enhances fat metabolism. In addition, it can be turned into ornithine, another amino acid, and ultimately urea, which make it very important for detoxification of the liver and urea system (Chaitow 37). Ornithine also makes glutamic acid, proline, and when combined with ammonia and carbon dioxide makes citrulline. Additionally, ornithine can regenerate arginine and citrulline (a specific amino acid used in the urea cycle), if attached to aspartic acid, can also eventually metabolize into arginine. Thus proving the beauty of this metabolic cycle.

The urea system is the system that allows for the removal of protein waste. When proteins break down, they produce nitrogen containing compounds as a waste material. Unlike fats and carbohydrates that are used or stored as fuel in the body, proteins are either recycled into other amino acids or proteins or excreted by the body through the urinary system. It is important that this system functions well to avoid a build up of toxins. Arginine helps by transporting and eliminating nitrogen (Braverman 147).

The second most abundant waste material in the body is ammonia. This is produced by deamination, a process where the nitrogen portion of an atom is removed. This happens with bacteria in the GI tract and also in the catabolism of DNA. While certain amounts of ammonia are needed to help maintain the pH balance in the body, excess ammonia can cross the blood brain barrier and cause a host of issues when the amount is too high. Therefore the body converts ammonia into urea as quickly as it is produced. This urea cycle is controlled by five different enzymes that are produced and stored in the liver and also stored in the kidney in smaller amounts. Arginine triggers the activity of the first enzyme to begin the urea cycle (Braverman 148). It is important that the body contains enough arginine to activate the urea cycle or the buildup of toxins would be deadly. Although just one part of the urea system, this amino acid is very important.

Arginine plays an important role with nitric oxide. As stated, arginine transports and stores nitrogen but it also excretes it within muscle. In the presence of excess nitrogen, arginine increases the production of nitric oxide in the endothelial cells surrounding blood vessels. This nitric oxide aids in relaxing and dilating the blood

vessels to help keep arteries flexible (Braverman 149). Research shows that the interaction of arginine and nitric oxide is what enables a man to have an erection. With sexual stimulation, nerves in the penis transmit signals that activate the enzyme that converts arginine to nitric acid which triggers an erection (Sahley 27). So while most scientists believe erectile dysfunction is caused by poor blood flow, it is in fact caused by a lack of an important amino acid.

In addition to erectile function, arginine is also crucial in sperm production. According to Dr. Leon Chaitow, eighty percent of seminal fluid comprises arginine (37). In some instances when there is a decrease in sperm production (not as a result of a disease) the condition is called idiopathic hypospermia. This can happen in individuals who have genetic blocks that make producing arginine difficult and therefore lead to this decrease in sperm. Arginine supplementation would be recommended.

Arginine also plays a crucial role in memory and learning. This again is promoted by nitric oxide. As well as acting as a vasodilator and increasing blood flow to the brain, it acts as a neurotransmitter to increase communication in the brain. It is true that as we age our concentrations of nitric oxide decline and perhaps this is why many elderly experience a slowing down of their mental capacities.

Muscle health is also supported by arginine. Arginine can create a substance called creatine. Creatine is able to produce energy in the body. It is used for muscle contraction and strength therefore making arginine important in the maintenance of muscular health. Those with low levels of arginine in their systems will have muscular weakness and fatigue (Sahey 26).

In addition to muscle health, arginine promotes the health of other tissues in the body. Skin, tendons, bones, cartilage and connective tissue are all primarily composed of collagen. As previously stated, arginine can convert to ornithine and ornithine can convert to proline (Braverman 157). Proline, when combined with glycine, creates collagen. Because of its ability to promote the health of tissue, arginine is also able to assist in the healing of wounds.

As arginine helps release human growth hormone from the pituitary gland, it is also able to assist thymus health. As we age, the thymus gland shrinks in size called thymus involution. This important gland produces hormones that aid in immune response. Studies done with rats show that arginine supplementation helps slow down thymus involution and also increase the rat's ability to fight cancer. Additionally, arginine can stimulate T lymphocytes, which are a type of white blood cell that is crucial to the immune system (Braverman 153). T lymphocytes are a defense system from harmful, unwanted substances in the body and can aid in reducing cancer cells.

There are a couple notes of caution, however, that go with arginine supplementation. First goes to those with the herpes virus. Arginine provides the materials for herpes replication and can cause a breakout in those with the virus. It is best to take 1g of lysine each day to counteract this as lysine blocks the replication of the virus and prevents breakouts (Sahley 31). Secondly, those with schizophrenia should not consume a dose of over 30mg per day as it may aggravate their symptoms due to the increase output of human growth hormone (Chaitow 41).

Some signs of arginine deficiency include rash, hair loss and breakage, poor wound healing, constipation, fatty liver, hepatic cirrhosis, coma, and hypoglycemia

(Sahley 30). Good food sources are nuts particularly peanuts, cashews, pecans, and almonds. You can also get a good amount of arginine from carob, chocolate, cabbage, cottage cheese, cheeses, gelatin, soy, yogurt, meats, eggs, brown rice, whole grains, and raisins.

Asparagine and Aspartic Acid

-Energy maker -Immune booster -Cancer fighter

Two very similarly structured amino acids, asparagine and aspartic acid are often conjoined in their descriptions. These non-essential amino acids assume a similar role in the body dealing with energy production and distribution. They are responsible not only for generating energy but for sending energy throughout the body's systems as it is needed.

If not gained from the diet, Aspartic acid is formed in the liver from glutamic acid with the help of B6. To a small degree by bacteria also help to form aspartic acid (Sahley 31). Asparagine is formed from a combination of aspartic acid and adenosine triphosphate (ATP), the high-energy compound that stimulates many activities within the body. This transition of amino acids compares to the conversion of glutamic acid and glutamine. They follow similar energy pathways in the body and when glutamine and asparagine release their energy to allow for fuel to the brain and nervous system, they both convert back into aspartic acid and glutamic acid (Braverman 191).

An amino acid that is found in high concentrations throughout the body, aspartic acid plays critical roles in two major body functions: the Krebs cycle and the urea cycle. Within the Krebs cycle aspartic acid helps to transport energy into the mitochondria of the cell. In the urea cycle it helps to stimulate the system so that ammonia and toxins are metabolized by the body and excreted through the urea (Braverman 191).

Aspartic acid also uses its energy to produce pyrimidine, an important constituent of our DNA and RNA. Pyrimidine forms the bases thymine and cytosine,

two of the four bases in the helix of our genetic coding (Sahley 31). So aspartic acid is necessary for the actual structure of our DNA, which in essence means aspartic acid helps to create who we are.

Another function of aspartic acid is its ability to be an excitatory neurotransmitter. In the brain it is particularly concentrated in the hypothalamus and hippocampus. An active form of aspartic acid, N-acetylaspartic acid is thought to be the most concentrated of the brain's amino acid neurotransmitters (Braverman 192). Even with this amount in the brain, aspartic acid's cellular energy ability is considered to be more important of its functions. But aspartic acid is a powerful neurotransmitter none the less. At high doses it can even over-excite cells to the point of cell damage or death. This is thought to be what happens when someone has a stroke and the over-excitatory neurotransmitter activity cause cell death and further damage.

In order to help maintain a balance in the central nervous system, asparagine comes into play. It is needed to help sustain a balance between either too much or too little excitement in order to prevent problems with the brain and nervous system. This is a place where asparagine is needed to maintain balance in the central nervous system. However, it is to note that there have been studies that find elevated amounts of asparagine in the brain after an epileptic seizure.

In addition to it's ability to give the body energy, aspartic acid helps build the immune system. It can participate in the production of antibodies and immunoglobulin and (Braverman 192) while also helping with the health of the thymus gland (Sahley 31). It is perhaps because of aspartic acid is able to provide energy and stimulation to cells.

Interestingly, cancer cells, particularly leukemia and lymphocytic malignant cells must get their energy from asparagine in order to replicate and grow. Generally normal healthy cells can make their own asparagine but cancer cells cannot. An effective pharmaceutical cancer drug called asparaginase (Elspar) is made from the enzyme L-asparaginase. This enzyme transposes asparagine into aspartic acid and thus eliminates the cancer cell's energy source (Braverman 195). While this type of medication is not a natural approach to health, the concept of using the enzymatic action to deny cancer cells their energy is a good concept for natural health practitioners to be aware of.

Another very important role of aspartic acid has to do with our assimilation of nutrients. Aspartic acid helps to move important minerals such as magnesium and potassium across the intestinal wall. Without aspartic acid, our cells ultimately would not be able to receive the nutrients necessary for their survival and function.

As with most amino acids, protein sources are the best food source for aspartic acid. Animal proteins such as turkey, sausage, chicken, eggs, and fish are excellent sources of aspartic acid as are cottage cheese and ricotta. Plant proteins are also a viable source of aspartic acid. Sprouting seeds are a particularly good source of this energy producing AA as are sesame seeds and soy products. Since the body makes asparagine from aspartic acid, there is no need to find asparagine in food sources.

Branched Chain Amino Acids: Isoleucine, Leucine, Valine

-Athlete's helper -Stress and trauma recovery

The branched chain amino acids, BCAAs, isoleucine, leucine, and valine, are often categorized as a group rather than as individual amino acids. They earn their name “branched-chain” from their structures that have branched points. Each of these three amino acids is considered essential and so must be obtained through the diet.

The branched chain amino acids are very similar structurally but they have different metabolic pathways. While they are all primarily metabolized by muscle in the body, they are metabolized through different routes. Leucine is broken down through fat pathways, valine is broken down through carbohydrate pathways, and isoleucine through both fat and carbohydrate pathways (Sahley 32).

While the branched-chain amino acids are categorized together and should always be taken together as a group, their individual amino acid components influence the body in different ways. Leucine is metabolized through the fat pathways. Found abundantly in muscle tissue, it plays a big role in its upkeep and repair. It is important to regulate energy in the body and muscles and is needed particularly after stressful events such as surgery, infection, and trauma since leucine is required to heal wounds (Sahley 33). Leucine regulates insulin production and blood sugar levels so it is important for diabetics. While it is very rare to have a leucine deficiency, it is more likely to occur with people with kidney or liver diseases.

Valine is metabolized through the carbohydrate pathways of the body. Also found abundantly in the muscle tissue, this amino acid is vital for the health of the muscle. It assists in muscle tissue repair, energy metabolism, and also nitrogen

balance. It is particularly needed by burn patients and trauma patients to heal tissue. Valine can also serve as a source of energy for the muscle itself. This amino acid is the part of the branched-chain trio that athletes specifically use for performance enhancement.

Deficiencies of valine are quite rare in the United States, primarily because of the excessively high protein content of most American's diets. However, alcoholics and drug addicts often suffer from a major deficiency of valine. Often they benefit from supplementation to help degenerative neurological disorders associated with heavy alcohol and drug use such as hepatic encephalopathy. Yet alcoholic and addictive cases aside, deficiencies of valine are possibly quite serious. Studies with rats at the University of Illinois have found that when valine is removed from the diet the animals develop unique neurological symptoms. They retract their heads, stagger, and go in circles aimlessly. In the area of the brain where the fascial and vestibular nerves are found the myelin sheath was degenerated (Braverman 245). Overall dietary nitrogen and proteins are not well absorbed. Additionally they found that removing valine from the diet resulted in damage to the nuclei of the brain and also the protein synthesizing machinery of the cell. Conversely, an excess or overdose of valine is also not ideal. This can result in delusions, vertigo, and fantasy ideas. The person will probably also have a crawling feeling on their skin or formication (the feeling that insects are crawling on you) (Sahley 34). The balance of valine, therefore, is important to keep the body in homeostasis.

Isoleucine is metabolized through both fat and carbohydrate pathways in the body. It regulates blood sugar, muscle development and repair, and even hemoglobin

development. As with leucine, the body's need for isoleucine increases after traumatic stress on the body such as surgery or infection. During strenuous exercise, isoleucine is used as an energy source. It has been found that people with chronic renal failure have a severe deficiency of this amino acid. A deficiency may manifest as headaches, dizziness, confusion, depression, irritability, and fatigue (Sahley 32). Additional symptoms of isoleucine deficiency may include muscle tremors and twitching of the muscles in the extremities (Braverman 245).

As a group, the BCAAs are essential for the maintenance of muscle and skeletal health. In tissue, leucine makes up 8% of all amino acids of body proteins which is astounding. In muscle, leucine is the fourth most concentrated following glutamic acid, aspartic acid, and lysine. Valine and isoleucine are close behind leucine. This high concentration of BCAAs in muscle is not surprising, though, since the muscle is primarily where they are used (Braverman 243).

In the muscle, branched chain amino acids are able to be great sources of energy. They are a major fuel involved in anabolism, the building phase of metabolism. They stimulate the synthesis of proteins, they assist in the re-utilization of other amino acids, and they help to decrease protein breakdown that happens during stress. Overall the BCAAs are a great source of fuel and energy under any type of stress but particularly in severe stress states such as trauma.

Generally when in a heightened stress state the bodies need for fuel increases primarily because of protein requirements. This high stress state can be triggered by fever, infections, surgery, trauma, starvation, and even activities such as weight lifting. When the body is stressed, proteins are rapidly broken down to fuel the body's

sympathetic dominant behavior. During this time amino acid utilization is increased three or four times more than in a non-stress state (Sahley 34). This catabolic process is how the body is able to survive and function when in a high stress state.

Branched-chain amino acids are able to slow down this catabolism especially when taken as a supplement. But as the stress state increases, more BCAAs and also B6 are needed to counterbalance the rate of metabolism of the body. In some hospitals for post-surgery patients and some trauma patients, BCAAs, particularly leucine, are given intravenously to help the body recover. Additionally, athletes and bodybuilders also utilize the protein protecting ability of these amino acids. BCAAs have been proven to enhance muscle-protein metabolism and improve muscle repair and health. Supplementation of BCAAs can provide athletes a healthier and safer alternative to steroids. It is very common to find protein shakes and supplements geared to athletes and bodybuilders that include BCAAs.

Another reason athletes use branched-chain amino acids is to help with their energy levels. In the body since the liver does not break the BCAAs down very easily they end up circulating longer in the system. As such, they compete for absorption from other amino acids, in particular tryptophan. Tryptophan is a precursor for serotonin in the brain and exercise also increases serotonin, but the ratio between BCAAs and tryptophan will influence the serotonin levels. Tryptophan can contribute to exercise related fatigue but increasing your BCAAs during exercise can postpone this fatigue. Studies of cyclists and cross country skiers have found that BCAAs do indeed improve performance, enable the athletes to remain more focused, decrease fatigue,

and allow for more exertion (Sahley 35). All this is done while still reducing the rate of protein degradation and muscle break down.

A safety note on BCAAs and athletic performance: balance is key. When BCAA levels increase in the body, the entry of the amino acids phenylalanine and tyrosine into the brain is impaired. This can temporarily inhibit brain function. Use BCAAs prudently! It is recommended to take BCAAs before a workout and then to supplement with brain-stimulating AAs such as phenylalanine and tyrosine after the workout to avoid brain imbalances. Supplement plans should be tailored to fit an individual's needs by a health professional and not be a self-serve situation.

Because of their ability to reduce muscle loss and degradation, BCAAs are being used for various “wasting” issues. They are being used to help astronauts deal with the difficulty of space travel where the lack of gravity influences muscle integrity. BCAAs are also being used to help those with Lou Gehrig’s disease, ALS, a severe musculoskeletal disease. This could be applied to someone perhaps recovering from a coma or temporary paralysis as well.

Muscle loss associated to a lack of BCAAs has been seen in people with anorexia nervosa. This eating disorder is characterized by an extreme fear of weight gain and a consequent refusal to eat. Patients with this disease are often found to have a dramatic lack of BCAAs and it is this lack of BCAAs that is attributed to the extreme muscle loss. However, work with people with anorexia has shown that increasing the BCAAs allows the body to rebuild its muscle mass.

Branched-chain amino acids also play a role in the function of certain endocrine glands, specially the pancreas and the thyroid. In people with diabetes, levels of

BCAAs are elevated, most likely because of isoleucine's and leucine's abilities to regulate blood sugar. Additionally, in diabetic rats, low insulin levels reduce the absorption of BCAAs and therefore cause levels of BCAAs and enzymes to rise. People with diabetes tend to lose muscle mass and require more BCAAs in their diet. People with hyperthyroidism are suspected of using BCAAs too rapidly since the hormone thyroxin, secreted from the thyroid, increases the transport of leucine (Braverman 249).

Cirrhosis is an advanced liver disease generally caused by long-term alcohol abuse. Cirrhosis is a degenerative inflammatory disease that results in scar tissue in the liver and the inability for the liver to function properly. Patients with cirrhosis have decreased levels of BCAAs. There is documentation showing that supplementing high levels of BCAAs are very useful for liver disease as they help the liver handle amino acid metabolism better. BCAAs can specifically slow the delivery of certain amino acids (the aromatic amino acids phenylalanine, tyrosine, and tryptophan, plus methionine) to the liver and thus allow the liver to handle easier. Aromatic amino acids are metabolized in the brain rather than in the muscle as the branched-chain amino acids are.

Those with alcohol-related cirrhosis have an increase in ammonia that influences the permeability of amino acids into the brain. This can cause the aromatic amino acids higher permeability and therefore throw off the balance of BCAAs in the body. However supplementing pyridoxine, or B6, can lower this ratio and bring a better balance to the body. Another instance where the aromatic to BCAA balance is thrown off is with hepatic encephalopathy. Generally, toxins are filtered by the liver, but when

there is a diseased liver, these toxins can make their way to the brain. This causes hepatic encephalopathy which can manifest in symptoms such as speech difficulties, disrupted sleep patterns, tremors, and more symptoms (Braverman 250).

The end stage of liver disease is hepatic coma. This is marked by an increase in ammonia and also tyrosine or tryptophan (aromatic amino acids) in the brain. There has reportedly been success in reversing this prognosis with the use of valine supplementation. Valine is able to compete with the tyrosine and tryptophan for entrance in the brain and allow the coma to be reversed. However, the balance of BCAAs and aromatic amino acids is but one facet of this disease. Cirrhosis is a complicated disease with many facets including a decrease in protein synthesis, excess of ammonia, and the abnormal metabolism of fatty acids.

For some individuals with psychosomatic problems, levels of leucine and isoleucine have been found to be deficient. Deficiencies of these amino acids are found in people with depression and even psychosis (Braverman 253). Since BCAAs remedy the hallucinations brought on by hepatic encephalopathy, it is thought that BCAAs could improve the hallucinations of schizophrenics.

Branched-chain amino acids are best absorbed by the body when taken together. These essential amino acids are found in high protein foods and meats and it is relatively easy to maintain them in the diet. Leucine is often found in higher concentrations of foods. Often the quantity of leucine may be double the combined totals of isoleucine and valine. Eggs and cheese are particularly good sources for a balance of the BCAAs.

Carnitine

-Heart Strengthenener -Fat metabolizer

Although carnitine is among the list of amino acids, in true essence, this substance is not actually an amino acid. Amino acids traditionally are used by the body to construct proteins or neurotransmitters but carnitine does neither of these. However, it is an amine, being derived from ammonia, and has similar functions of providing energy as do other amino acids, so it is considered an amino acid.

Carnitine is synthesized in the liver, kidney and brain therefore it is a non essential amino acid. It is converted from lysine and also from methionine. In order to do so, the body must have adequate amounts of vitamin c (Braverman) and according to Drs Sahley and Birkner, vitamins B3, B6 and iron are also needed for carnitine conversion from lysine and methionine (36). It also goes to show that when someone has a carnitine deficiency, there will be a deficiency in lysine and methionine as well. Other precursors for carnitine are threonine and tryptophan, but lysine is particularly effective at increasing carnitine in the body (Chatter 71).

Carnitine is important in cellular energy. It is required to transport fats, specifically long chain fatty acids across the cell membrane of the mitochondria so they can be utilized as energy (Chaitow 72). The more carnitine available in the system, the faster these fats are transported and used for energy. The energy produced is stored in the body, but not as fat. Instead, this energy is stored as adenosine triphosphate (ATP). The energy of ATP is used to trigger many systems of the body and provide quick energy to cells. Carnitine is therefore very important in the

body's ability to regulate fat metabolism and also as a source for energy (Braverman 274).

Another important function of carnitine is its ability to reduce ketones in the blood in the case of ketosis. Ketones are fat waste byproducts (acid waste) that are not completely oxidized or broken down and build up in the blood. A build up of ketones results in a high blood acidity called ketosis. Ketosis can occur in people with diabetes who are unable to metabolize carnitine properly and also in people who partake of high-fat, high-protein diets. This over acidity in the blood caused by ketosis can have symptoms such as bladder issues, irritable bowel syndrome, water retention, arthritis, insomnia, migraines, and low blood pressure (Braverman 275). This high acidity can result in calcium, magnesium, and potassium loss which can be life-threatening (Chaitow 73). In addition, a build up of ketones is extremely toxic to the brain and the nervous system (Sahley 40). It should be noted that high-fat diets often result in a shortage of carnitine in the body (Braverman 276) which highlights the danger of eating a dangerous weight loss diet that allows eating high fat meats like bacon routinely. This highlights the importance of a balanced diet and proper nutrition for optimal health.

Many people chose to start keto-type diets in order to lose weight, even though this is not necessarily a wise or healthy choice. These diets focus on eating large quantities of meat and protein. Interestingly, carnitine is primarily found in meat, and nearly none is found in vegetables. Of course a balance of vegetables in the diet is necessary for many functions including containing minerals to help the body metabolize the proteins and fats of the meat. Yet in reference to weight loss, carnitine

can help people lose weight. It increases the rate at which fat is metabolized into fuel and additionally increases energy to the muscles and body. This allows for a person to be able to exercise for longer amounts of time before fatigue. So indeed by eating meat, it is possible to loose weight. Or more specifically, consuming the carnitine found in the meat will help you loose weight.

In the body the highest concentration of carnitine is found in the heart. Carnitine is essential for normal cardiac function. One primary way is in its ability to use fatty acids for energy thereby reducing the buildup of these toxic fatty acid waste products in the cells of the heart. If a buildup of these fatty acids were to occur, the heart can have impaired rhythm, impaired contraction, and even death of heart tissue (Sahley 37).

Conversely, carnitine is often used to help improve conditions of angina and heart disease. It is beneficial in recovery from a heart attack, congestive heart failure, and arrhythmias. Carnitine can increase heart and pressure rate and increase muscle strength. Many studies show that oral supplementation of carnitine helps heart patients recover much faster than when not supplementing with carnitine (Sahley 38). It is interesting to note that according to the American Red Cross, the leading cause of heart attacks in the country is caused by diet. Since Americans eat such high fat, high carbohydrate, low produce diets, it is no wonder that even though meat contains carnitine, the proportion of fat and sugar overwhelms the carnitine to effectively do its job! It seems that finding balance, eating the meats that are digestible to one's blood type, and prioritizing nutrition, we could greatly reduce the occurrence of heart disease in our country.

Another place that carnitine is found in the body, or that is, a male's body, is in sperm. In sperm, carnitine helps provide the energy for sperm motility. Sperm motility is necessary for the sperm to navigate through a woman's reproductive tract for the sake of fertility. Not surprisingly, men who are infertile tend to be very low in carnitine. This piece of information can be a wonderful tool to help couples conceive with natural supplementation. Interestingly, carnitine is also found in high amounts in the colostrum of the breast milk. It is believed that this is because an infant's body is developing quickly and requires an immense amount of energy for this growth (Braverman 275). For the natural health practitioner working with couples planning a pregnancy, this is excellent proof to examine the amino acid health of each parent before conception.

The name carnitine is like the word "carnivore", being that it was discovered in meat. It still is the best source of carnitine, specifically muscle meat or beef, pork, and lamb. There is a great concern for vegetarians since meat is not a part of their diet and implies a dangerous lacking of carnitine in their systems. Lysine and methionine, the precursors of carnitine, are also very difficult to find in non animal sources. Beans are low in methionine but do contain some lysine. Corn, wheat, and rice contain some methionine but are low in lysine. By carefully combining such foods, a vegetarian can avoid a carnitine deficiency, however this takes attention, planning, and preparation.

Cysteine and Cystine

-Detoxifier -B6 utilizer -Hair curler

Cysteine is a conditionally essential amino acid. It is conditionally essential because infants are unable to manufacture this amino acid on their own and must get it from breastmilk. However to the grown, this amino acid becomes nonessential.

Cysteine has a sulfur containing group. This means that it contains a sulfur and hydrogen atom bonded together. Garlic is an example of something high in sulfur and has been used for millennia to detoxify and cleanse the body. Sulfur is known as the heating element for its ability to “burn” away at impurities. It keeps the blood clean, helps the liver function, and keeps brain tissue healthy. Cysteine has an even higher quantity of sulfur than garlic does and as such its detoxifying ability is even greater. It is an antioxidant, destroys free-radicals, enhances the metabolism, and chelates copper from the body primarily through its sulfur compound.

Cysteine is formed in the body from the essential amino acid methionine plus a sulfur compound. Cysteine is a rather unstable and highly reactive element within the body. So once within the body, two cysteine molecules bind together into a disulfide bond or double bond forming cystine. Cystine is simply two cysteine molecules bonded together into a more stable form (Braverman 107). In order for these transformations to take place, adequate amounts for B6, B12, and folic acid must be present in the body. If the body is low in B6, the initial transformation from methionine may have errors that can result in mental retardation and low blood platelets.

While B6 is necessary for the conversion of cysteine from methionine and into cystine, cysteine is also necessary for the utilization of B6 within the body (Sahley 43).

The lack of B6 within the body is correlated to the presence of chronic degenerative disease. In studies of 24 hour blood and urine levels for both mental and physical chronic degenerative illness, B6 utilization disorders correspond to the presence of the disease. The results of these tests show that that in part, B6 deficiency is attributed to insufficient levels of cysteine in the body. It is found that it is the step of forming cysteine from methionine is impaired or prevented in patients with chronic diseases. A solution then to this deficiency is to simply supplement with cysteine until the body is able to regain the ability to do this on its own. In this instance, cysteine is preferable than cystine since the simpler unbounded form is easier to break down and thus more readily able to contribute its sulfur element to the body (Chaitow 78).

The bonded molecule of cystine is very strong and helps with the form of protein structures. It builds proteins found in digestive enzymes but also hair, skin, and fingernails. Essentially, in proteins high in keratin, cystine gives texture such as straight or curly hair. It also lends the strength to nails and to why a tortoise shell is so hard (Braverman 108). The strength of its double bonded molecule also allows gives gluten its elasticity and is why bread dough is stretchy.

Cysteine primarily shows its worth in the body by being a powerful detoxifier. It can protect the body against damage from cigarette smoking and alcohol to such an effect that it can eliminate a hangover (Chaitow 78). It has also been found to reduce damage to the body from smoking such as in emphysema while protecting the liver and brain from the damages of alcohol. Yet one of cysteine's most influential roles as detoxifier happens when it helps to form glutathione.

Glutathione is a small protein that is made three ingredients: cysteine, glutamic acid and glycine. This tripeptide (the three ingredients) is super tiny but it acts as a powerful waste eliminator and toxin neutralizer in the body. Of the three peptides that form this tripeptide, cysteine is the most important because it is cysteine that determines how much glutathione the body needs. Also, cysteine has a thiol group (its sulfur element) that gives glutathione its power (Braverman 108).

Glutathione is incredibly important. In the liver it detoxifies carcinogens and neutralizes dangerous pollutants that would otherwise destroy your liver with their level of toxicity. Throughout the body it acts as a scavenger to seek out dangerous oxidants and neutralizes them. Without glutathione, the cells of the body would be destroyed from oxidation. In addition to seeking out these hazards, glutathione helps the body to recycle other helpful antioxidants like vitamins C and E.

Glutathione is present in every living cell and its abilities are incredible. It is involved in the product of red blood cells. It is a neurotransmitter that plays an important role in the brain. It can help the liver by preventing or even reversing alcohol related cirrhosis. Glutathione is found in high concentrations in the cornea and a lack can cause cataracts. It is the go-to for drug overdoses. There is a connection between low levels of glutathione and emotional disorders such as manic depression. It helps neutralize heavy metals in the body. It can protect the brain from Parkinson's disease. It can improve the prognosis of stroke victims. It protects the stomach from ulcers and can even regress the development of cancerous tumors. What a powerful peptide! All this is due to the presence of cysteine in its makeup.

Another powerful version of cysteine used to detoxify the body is NAC or N-acetyl-cysteine. NAC is a specialized modified form of cysteine that has been studied extensively. Originally produced for by Mead Johnson for treating excess mucus, NAC has now been studied much more than cysteine itself has (Sahley, 43). This, of course, has to do with money. Cysteine is a naturally occurring substance that cannot be patented. However, it's closely related counterpart NAC can be produced synthetically in a lab and therefore is a patented product.

NAC is a powerful antioxidant, even more so than vitamin C. It is used in emergency rooms for toxic overdoses especially overdoses of acetaminophen (Tylenol). Doctors who prescribe pulmonary, cancer, or cardiac medicines use it as well to help reduce the toxicity of their toxic prescriptions. In fact, NAC has been studied extensively in cancer research especially in its ability to protect the body from the gamut of harmful and toxic medications and treatments used in typical cancer care. It has been shown to help with the toxic side effects of chemotherapy and with radiation treatment. It can be used internally and has also been used externally as well to help prevent hair loss, skin damage, and to protect the mucus membranes of the eyes.

Studies have also found that NAC helps to improve the condition of those with heart problems when combined with nitroglycerine. It is able to reduce the symptoms of coronary artery disease such as chest pain and heart attack. NAC also has been shown to help those with kidney stones in a therapeutic and preventative role.

In 2010 researchers found that NAC offers some protection against the bird flu (Sahley 44) by mediating the inflammatory response in the cell. Additionally, NAC has been found to help with influenza symptoms and is often used as a preventative

supplement in the winter months. In part because of the effectiveness of NAC to help with these flus, it is now used for the treatment and healing of COVID.

Both glutathione and N-acetyl cysteine are made powerful and effective by the presence of cysteine in their makeup. As mentioned earlier, cysteine is a sulfur contains group so foods that contain sulfur will contain cysteine. This includes garlic, onions, muscle protein, egg yolks, mustard, horseradish, cabbages, and asparagus. Unfortunately, sulfur as a mineral is very deficient in most of the world's soil. Therefore the foods grown in such soil will have less sulfur, selenium, iodine, and zinc in their biochemical makeup. This is particularly true in glaciated areas. In these cases, supplementation may be necessary.

It is also important to note that people who may be taking large amounts of phenylalanine and tryptophan will most likely have a decrease in cysteine levels. When cysteine levels drop, all antioxidant levels in the body drop and all aging diseases advance (Braverman 111). Of course the goal is to find balance in the body of vitamins, minerals, and amino acids so that one can function at optimal health.

GABA

-Anxiety relief -Panic Attack Stopper

While not a true amino acid, Gamma Amino Butyric Acid, GABA, is a neurotransmitter that deserves its own mention. GABA is an inhibitory neurotransmitter meaning that it slows down information in the brain. GABA was discovered in 1950 by Dr. Eugene Roberts who established that this neurotransmitter was involved in nerve impulses and thoughts. In the 1970s the presence of GABA receptor sites throughout the brain and body was established by Dr. Candace Pert who's research highlighted the importance of GABA in the stress network in the body. By January 1998, over 3,000 documents and texts were already in print highlighting the importance of GABA in the stress response (Sahley 45).

In the brain, 40-50% of all synapses contain GABA. This widely distributed neurotransmitter has a vital role in neuron and behavior inhibition. When stress is experienced, the limbic system signals the fight-or-flight response in the body. Eventually these signals overwhelm the cortex, or decision making area of the brain, and the system becomes exhausted. It is important that at some point these messages from the limbic system are inhibited so that they do not flood the brain and paralyze decision making. GABA plays a big role here. It inhibits cells from firing and also fills certain receptor sites itself so that the panic message is slowed down and less of it reaches the cortex. By slowing and blocking this communication, the decision making part of the brain is not overwhelmed and is able to maintain control and calm.

However, it is possible to exhaust this system and deplete the body's GABA reserves. Prolonged stress uses up the body's available GABA and at some point there

is a deficiency in this neurotransmitter and therefore its ability to inhibit is impaired. In situations like this, the body and brain become exhausted and unable to think clearly. Panic and anxiety are able to move in and the person senses fear and pain from every angle thereby resulting in a panic attack. In a panic attack, symptoms can include trembling, sweating, weakness, disorientation, difficulty breathing, relentless fear, headaches, diarrhea, depression, and wooziness (Sahley 46).

If GABA is administered during a panic attack, within 10-15 minutes the symptoms will lessen since the brain is receiving what it needs to calm the stress response. Studies have shown GABA can mimic the effect of tranquilizers such as Valium or Librium, but GABA has none of the negative side effect of these chemical drugs. GABA is what the body needs in order to behave in a healthy way and this nutrient is much safer and more effective than synthetic sources. "Human behavior involves the functioning of the whole nervous system, and the nervous system requires amino acids. GABA, glutamine, and glycine proves vital for energy and the smooth running of brain functions" (Sahley 47).

As GABA is so necessary for healthy cognitive functioning, it is not uncommon to find a GABA deficiency where there are cognitive issues. Conditions like schizophrenia and convulsive seizures typically go hand in hand with GABA deficiency. Stroke victims have success with GABA supplements for healing. Mood swings and depression are benefited from GABA as well. Significant benefit has been found for people who suffer from anxiety, as may well be believed.

Glutamic Acid

-Muscle repair -Brain detox

Glutamic acid is a nonessential amino acid that can be synthesized by the body. It is considered to be an excitatory neurotransmitter which means it can stimulate the brain by the firing of neurons. It is synthesized in the body from many different amino acids primarily glutamine and GABA but also ornithine, arginine, aspartic acid, and proline. This ability for the body to make glutamic acid from so many other substances makes a deficiency in this amino acid nearly impossible (Sahley 48). Glutamic acid easily loses its amine group and as such it participates in reactions that are vital to the formation of other non-essential amino acids. When glutamic acid is combined with ammonia it becomes glutamine. It is also the precursor of GABA, an inhibitory neurotransmitter, and also glutathione (Chaitow 75).

Glutamic acid is found in the brain and the spinal cord. In the brain it is particularly found in the hippocampus, the memory center of the brain. Additionally it is found in the cranial nerves. Glutamic acid is a very prolific neurotransmitter. It is involved in all brain cells, the photoreceptors of the brain and it is present in nearly every nerve cell in the body (Braverman 165).

After glutamic acid is converted from glutamine, it acts on the brain in two main ways: it acts as fuel for the brain and also detoxifies ammonia from the brain. The brain is able to use glutamic acid for fuel just as it uses glucose. However, since the brain is unable to store significant amounts of glucose, it often relies on glutamic acid as a fuel source. The presence of glutamic acid is necessary to eliminate excess ammonia from the brain so that the brain is able to function at a high gear. A shortage of glutamine

and therefore glutamic acid in the diet results in brain damage from the excess ammonia (Chaitow 76).

Extremely large doses of glutamic acid can be dangerous and produce brain damage. But even moderately large doses of glutamic acid can be problematic. Problems like headaches, intestinal discomfort, GI disturbances, and even some neurological problems can happen if glutamic acid is out of balance. The importance for balance in amino acids cannot be stressed enough.

Glutamic acid is found in many seaweed and sea animals especially crustaceans. In fact this seaweed connection links glutamic acid to monosodium glutamate or MSG. MSG is a salt form of glutamic acid that has been used by the Chinese food industry for decades. Originally the Chinese used seaweed extracts to flavor their food but chemical analysis in the early 20th century found that MSG was what was being used to season food.

MSG is the sodium salt of glutamic acid and it is much more toxic. Than glutamic acid. Many people (as much as 30%) of people who regularly eat Chinese food suffer from Chinese restaurant syndrome or CRS. The combination of salt plus MSG gives the people who suffer from CRS symptoms of headaches, nausea, blurred vision, dizziness, vomiting, chills, depression, and dry mouth. On it's own, MSG is very toxic even in low doses and high doses can damage the brain structure of infants and animals especially the hypothalamus. Even though its use as a food additive is a significantly small dose, many people are hyper-sensitive to MSG and are encouraged to avoid it (Braverman 171).

Glutamine

-Intestinal importance -Wound healing

This conditionally essential amino acid is the third most abundant amino acid in the brain and blood. The highest concentrations are found in the skeletal muscle (about 60% of the body's supply of glutamine), brain, liver, and stomach. Glutamine is also found in high amounts in the cerebrospinal fluid and as such it is the only amino acid that easily and readily passes the blood brain barrier (Chaitow 75). In fact the concentration of glutamine in the blood is 3-4 times more than any other amino acid and it's concentration in cerebrospinal fluid is 10-15 times more than in the blood.

Unique to glutamine is its chemical structure. Glutamine contains two nitrogen atoms rather than just one as other amino acids have. This dual nitrogen allows glutamine to be a valuable vehicle to transport nitrogen throughout the body. This is particularly important in DNA synthesis as glutamine's nitrogen manufactures major components of DNA the purines and the pyrimidines.

Generally the body is able to synthesize all of the glutamine that it needs, but some conditions require that it is found in food or supplementation. This conditionally essential amino acid is required after the body has had times of extreme stress such as fever, illness, trauma, chemotherapy, etc. The body uses glutamine to help repair muscle and keep immune cells healthy and so it requires additional help with its glutamine supply.

In fact, the immune system is where glutamine shows its amazing abilities. It supports the reproduction of white blood cells that strengthen the body's defenses. It heals wounds. It supports and maintains glutathione, whose importance has been

mentioned previously. During times of illness the body requires extra glutamine to help support the kidneys, intestine and liver. Glutamine has antioxidant properties and even supports the pancreas while being an invaluable nutrient for the gastrointestinal tract (Sahley 50).

Glutamine is the primary nutrient needed for intestinal repair. In times of physical stress and trauma, the intestine suffers. Leaky gut, or intestinal permeability, are often a result of high levels of stress in the body. Stress detours the glutamine otherwise needed in the intestine towards the bloodstream so that it can be carried to specific tissue that need it for repair. However, this means that the glutamine is not as present in the intestinal tract. Trauma causes an increase in glucocorticoid which accelerates protein breakdown, especially in the intestine. Even though the skeletal muscles will send glutamine where it is needed to maintain a level of structural integrity, it is the loss of systemic glutamine that is a major problem during high stress times. As glutamine stores are depleted, wound healing is impaired, and this includes the intestinal wall. As a result, toxins, bacteria, and fungi are able to pass through the brush border system into the body (Sahley 51).

Another reason leaky-gut syndrome is so prevalent today is from the use of over the counter medications such as Motrin, Tylenol, advil, etc. The permeability of the intestinal wall allow many particles to pass through and can cause an increase of food allergies and sensitivities. But glutamine is the substance that will heal this damaged intestinal wall. And by healing the intestine, the entire immune system is strengthened. Indeed glutamine is an invaluable nutrient for the body.

Glycine

-Nerve soother -Autism controller

Glycine is a nonessential amino acid that has the simplest chemical structure of all the amino acids. Glycine's simple construction resembles sugar and it derives its name from glucose. This sweet tasting amino acid has the unique ability to build up glycogen levels in the liver thereby freeing up glucose for use in the body. But even on its own, it can be used as a sweetener and is good at masking bitterness and saltiness.

In spite of its sweetness, though, glycine is very effective at reducing sugar cravings. Some may even use it as a sugar substitute for some foods such as cereal. It's ability to help curb sugar cravings extends beyond simple sugar consumption. Glycine can be used to treat alcohol withdrawal with its ability to curtail the cravings associated with the sugars in alcohol (Sahley 56).

This important amino acid is used in the formation of many other amino acids and is part of the trio that creates glutathione. The body uses glycine for many things including forming DNA, collagen, phospholipids, skin proteins, and hemoglobin. There are receptors for glycine in the brain, spinal cord, and central nervous system. Like GABA, Glycine is an inhibitory neurotransmitter that has the ability to pass the blood brain barrier. Its inhibitory ability make it a required part of the functioning of the nervous system.

In fact, many people with spinal spasticity have been treated successfully with glycine. People with spastic disorders have very low levels of glycine in the blood. Spastic issues are associated with postsynaptic inhibition or an uneven transfer of nerve impulses in the spinal cord. The inhibitory aspect of glycine seems to alleviate

the erratic nerve communication and eliminate the spasticity of the spinal cord (Braverman 216).

There are high concentrations of glycine in the skin and connective tissues and as such, glycine is an important amino acid in wound healing. It is the most prevalent ingredient in wound ointments along with zinc. Collagen is extremely high in glycine, proline, and arginine, and in fact collagen is the richest dietary source of glycine, so glycine is a necessary part of skin healing.

Studies of glycine have found that it increases levels of growth hormone. A clinical trial measured a significant rise in growth hormone two hours after ingesting a large amount of glycine. The amount of growth hormone was ten times the amount of the baseline. This points to an important relationship between glycine and the functioning of the pituitary gland (Braverman 214). Further studies are needed to really understand this connection, but the implications are very strong.

There is a derivative of glycine called dimethylglycine or DMG. This substance occurs naturally in the human body but at such small amounts that it can barely be detected. However, this compound, which is found in small amounts in cereal grains, meats, and seeds, is an important compound for things including methionine and choline (Vit B factor necessary for the synthesis of acetylcholine), hormones and even DNA. Initially DMG was identified in Russia during work with vitamin B15. DMG was found to help cardiovascular function, improve oxygen utilization in the body and improve liver function (Braverman 218).

By 1975 research on DMG began in the United States and much of it supported what Russia had found. There are claims that it strengthens the immune response,

boosts physical and mental performance, and improves many aspects of cardiovascular function. It apparently can also help detoxify the liver, improve autism, reduce seizures, improve sex drive, prevent hypoglycemia, lupus, fatigue, diabetes, allergy, muscle cramps, arthritis, and pain. This product seems like a wonder-cure but in fact most of its benefit comes from the conversion of DMG to glycine.

When DMG breaks down into glycine, it generates two carbon molecules which are beneficial to the cell. This stimulates enzyme activity to deal with oxidative issues which may protect the DNA and improve triglyceride levels. The increase of oxidative enzymes may prolong the effects of choline, or B15, by slowing down its breakdown. So in reality, it is most likely a combination of effects of different nutrients playing on the cell that really brings about the positive results. However, there is a lot of implication with the benefit of DMG. The primary interest seems to be in its ability to control autism and epilepsy. Yet, even then, it is believed that supplementation with glycine alone may have similar benefits.

The vegetarian will have more success at consuming this amino acid than others since glycine is found in many non-animal sources. Beans, brewer's yeast, legumes, grains, dairy products, and seeds, all contain good amounts of glycine. This amino acid is easy to absorb due to its molecular similarities to glucose and therefore can work quickly in the human system.

Histidine

- Arthritis ease -Myelin sheath support

One of the essential amino acids, histidine is most important during infancy. Infants are unable to synthesize histidine so it is very critical for them to get this amino acid through breast milk. Children and adults are able to process small amounts of histidine but generally it must be obtained through the diet. Most of the histidine in the body is found in hemoglobin. It is manufactured in the liver from glutamic acid. As the name implies, histidine plays an important role in histamine production in the body. When the acid group from the amino acid is removed, it becomes histamine (Chaitow 41). This transformation can only occur with vitamins B6 and B3.

Although much of the histidine/histamine connection is not fully understood, there is a definite connection between them. Some studies show that increased levels of dietary histamine do not always increase histamine in the brain. Also, supplementing with histidine may initially lower blood levels of histamine by as much as 15% and then 24 hours later cause a 20% increase. There is a paradox between the relationship of these two substances that is being studied further (Braverman 286).

Histidine and histamine both play chelating roles with trace minerals and metals such as zinc and copper. Therefore histidine is sometimes used in removing copper, iron, or heavy metals from the body (Chaitow 41). This has especially been used in certain cases of arthritis where metals inflame tissue. Histidine and histamine both are able to attach themselves to the metals and remove them from tissues.

Histidine is particularly beneficial for rheumatoid arthritis. Studies have found that in patients with rheumatoid arthritis, the only amino acid that is out of balance is

histidine. Arthritic synovial fluid is particularly low in histidine. In fact the amount of histidine in the system can be used to indicate how advanced the arthritic condition is. When histidine is supplemented, patients have improved grip strength and walking ability (Braverman 289).

The balance of histidine and histamine in the blood and brain have implications for mental health. A study by Pfeiffer and Iliev of the Brain Bio Center showed that two-thirds of all schizophrenia patients fell into one of two categories dealing with this balance. The histapenic patient, one with very low levels of histamine in the blood and the brain, suffered from being extremely over stimulated. Where as the histadelic patients, those with very high levels of histamine in the blood and brain, were usually suicidally depressed (Chaitow 42). In the case of the histapenic patients, histidine supplementation would be recommended. And in the case of the histadelic patients, the amino acid methionine would be recommended as methionine is able to detox histamine from the system.

Another important factor for histidine is that it is necessary for the maintenance of a healthy myelin sheath (protective fat that insulates the end of nerves) (Sahley 57). Because of this, it is found to be very important for the auditory nerve specifically. There has been some success with histidine improving hearing disabilities that result for issues with the auditory nerve. It seems to be understood that where there is a lack of histidine there will most likely be a lack of hearing, that is, nerve deafness (Chaitow 42).

Although not fully studied, there is a correlation between histamine levels and sexual performance and arousal. The release of histamine from stores in the body is

necessary for sexual arousal. Histamine facilitates orgasm in both men and women. It is possible for those with sexual issues to supplement with histidine, B3 and B6 (the two B vitamins necessary for the synthesis of histidine to histamine) to help alleviate these issues (Chaitow 43).

Histidine is mostly found in animal and protein sources. Eggs, beans, dairy, meats, fish, nuts, and seeds all carry the highest amounts of this amino acid. Very little is found in grains and cereals.

Lysine

-Herpes helper

Lysine is an essential amino acid and therefore must be obtained from the diet. Lysine is found in high concentrations in muscle tissue. This amino acid is the precursor for other amino acids including carnitine. It also assist in transamination, the transfer of amino groups, since it itself is composed of two amine groups (Braverman 262).

However lysine shares the same transportation system with arginine and as such they are antagonistic. Both of these amino acids must travel through the intestine wall and therefore are in competition. An excess of one of these amino acids will create a deficiency in the other. Another example of the importance of proper amino acid balance.

Lysine has a large role in the strength of the immunological function of the body, in part because it influences the thymus gland. Lysine stimulates thymus growth and also the production of thymus factors. Since the thymus gland is responsible for the formation fo T cells and B cells, this important gland is paramount for immune response.

However, lysine is most specifically associated with its ability to help fight the herpes simplex virus. Herpes is a virus that generally manifests through lesions on the skin. There are two main types: Type I and Type II. Type I herpes manifests its sores around the mouth causing cold sores or blisters. Type II manifests in painful lesions in the genital area and is considered a sexually transmitted infection or STI. An additional type of herpes, herpes zoster virus, causes shingles or painful blisters along the rib

cage (Sahley 58). It is the same virus that also causes chickenpox. Lysine, however, is effective at helping all types of herpes viruses.

While it may be assumed that the herpes virus is a disease of the skin, it is in fact a disease of the nerves. After a person suffers the primary outbreak of a herpes sore, the virus then settles in the nearby nerves and spinal ganglia where it lies dormant. Every time there is another outbreak, it always begins in the ganglion cells and passes down the nerves where it forms a blister on the skin or in the mucous membranes. According to Dr. Braverman, the herpes sore “represents the rim of the volcano” (267). Indeed every cold sore on the mouth has its root in the base of the brain where the cranial nerves feed into it. A more accurate description of herpes would be a chronic disease of the nerves that occasionally manifests on the skin.

Since herpes is a disease of the nerves, there are many other diseases that are suspected to be a result of the herpes virus. This includes additional skin and mucous membrane issues such as eczema, canker sores, and conjunctivitis. It is suspected to be associated with disorders of the central nervous system such as meningoencephalitis (swelling of the brain and surrounding membranes), trigeminal neuralgia (neuralgia in the trigeminal nerve of the face), myelitis, and Bell’s palsy. Herpes is also suspected to be the root cause of systemic infections such as acute respiratory disease, pneumonia, hepatitis and cystitis (inflammatory condition of the bladder). In addition, malignancies such as cervical cancer and oral cancer are thought to be connected to the herpes virus (Braverman 269). Indeed, the “simple” herpes simplex virus is anything but.

The discovery of the role of amino acids in herpes development happened many years ago through a chance observation by Dr Chris Kagan at the Cedars of Lebanon Hospital in Los Angeles, California. Dr. Kagan found that cultures of the herpes virus always grew very rapidly with the presence of the amino acid arginine added to the solution. Another scientist, Dr. R Tankersley researched and found that when lysine was added to the solution, the growth of the herpes virus was slowed down instead. This research spearheaded the therapeutic application of lysine for helping those with the herpes virus. The results were incredible with 43 out of 45 patients drastically improving with lysine supplementation and reducing arginine (Chaitow 47). Again the importance is in finding the right balance with these amino acids. Their research found that does not take long for lesions to reappear if the balance of arginine overcomes lysine again.

Over the years, however, the connection to lysine and herpes has been challenged. There are many additional factors that contribute to a herpes outbreak including stress, depression, mineral and vitamin balance, and lifestyle. While it is not fully understood if the benefit of lysine has to do with just lysine or the balance between lysine and arginine, it is still considered to help shorten the duration of cold sores. However, treatments of high doses of zinc and vitamin c have also been found to lessen the life of a cold sore.

Lysine is also often used in the treatment of heavy metal toxicity especially with lead. This has been particularly noted in the elderly, since lead and other toxic heavy metals tend to accumulate in their systems. Lysine has been shown to fight heavy metal toxicity.

Lysine also helps the elderly with bone density. It is able to increase the rate of absorption of calcium from the intestines and prevent the loss of this important bone mineral through the urea cycle. Those with osteoporosis can find relief with lysine supplementation, and in fact deficiencies of lysine are considered one of the factors that cause osteoporosis in the first place. Lysine can also help boost bone manufacturing cells (Sahley 59).

Some foods that are particularly high in lysine are wheat germ, cottage cheese, and chicken. Eggs, fish, soy, and yeast also have good amounts of lysine. Lysine quantities in vegetables is unremarkable and as such lysine often becomes the limiting amino acid in these foods, meaning it is the first to become deficient (Bragerman 263). However, arginine is high in vegetables, compared to lysine, so it is possible that the presence of arginine in vegetables competes with the lysine and causes the deficiency.

Methionine

- Detoxifier -Allergy helper

Methionine is an essential amino acid that has a sulphur group. Methionine has the ability to donate part of its structure to other molecules, thus earning the name “methyl donor”. The ability for methionine to donate this methyl group makes it imperative for the formation of very important substances such as epinephrine, lecithin, melatonin, collagen and nucleic acid. Nucleic acid is essential for forming RNA and DNA which of course are vital to every cell in the body (Chaitow 49). Methionine also helps form the amino acids carnitine, serine, cysteine, and cystine. In fact, it is believed that methionine can boost the levels of all amino acids in the body.

Methionine is not present in high quantities in any particular area of the body. It can pass the blood brain barrier but low amounts exist in the brain. In the muscles, there is a significantly small amount of methionine compared to other amino acids. Even the cerebral spinal fluid, there is scant amounts. Yet of the sulfur amino acids, methionine is the most abundant in the body. But in order for it to be metabolized by the body, there must be sufficient amounts of vitamins B 6, B 9 and B 12. Methionine has three main roles in the body: contributing sulfur, donating methyl, and being an important precursor to cysteine, glutathione, and taurine (Braverman 86).

As the body’s main sulfur containing amino acid, methionine contributes the mineral sulfur to the body. This ability can help the body resist disease if it is the type that can result from an imbalance of the alkaline-acid balance. Methionine’s sulfur properties also help it to stimulate translation of DNA instructions for which of the bodies proteins are needed in the body and where (Braverman 86).

Methionine's ability to donate methyl allows it to combine with adenosine triphosphate (ATP), the body's energy molecule, to make an active form of methionine. From this active state, methionine can contribute its methyl group to the formation of additional important sulfur compounds such as other amino acids and even endorphins. An interesting thing about sulfur amino acids is that they have the ability to protect against radiation (Chaitow 49).

As part of the sulphur amino acid group, methionine is excellent as a detoxifying agent. Methionine is able to help the body eliminate dangerous toxins including lead. However, in order for methionine to be effective at eliminating lead, it is necessary to supplement this amino acid, as the quantity needed from food sources would be nearly impossible for the average person to consume.

Methionine has also been found to help neutralize the negative effects of alcohol on the body. Alcohol is an oxidant that can stimulate the release of superoxide radicals which are dangerous to the body (Chaitow 49). Methionine is able to help protect the body from these alcohol substances. In addition, methionine can help protect and treat the liver in the case of acetaminophen or methotrexate (a chemotherapy drug) poisoning (Sahley 60). One of the reasons methionine is such an effective detoxifier is that it stimulates the body to create glutathione, which as mentioned previously in this paper is an extremely powerful detoxifying agent.

A caution on methionine supplementation. Part of methionine's metabolism is the synthesis of a type of cysteine called homocysteine. Homocysteine can cause a build up of plaque in the arteries that can lead to cardiovascular disease (Sahley 60). It is important when supplementing methionine that the body has adequate amounts of

B6 and B9 in order to prevent this buildup of homocysteine. If these B vitamins are not in sufficient amounts in the body, they will influence the cycles of arginine and ornithine, which are needed for the urea cycle. Additionally, if these vitamins are not present and arginine and ornithine are unable to synthesize from methionine, they can build up as polyamines, amino acid compounds. These compounds can be dangerous because they can promote cell growth, including cancer cells (Braverman 87).

Yet methionine has an even deeper connection to vitamin B9. This vitamin is known as folic acid or folate (the natural, whole-food formula). When the body is low in methionine, the body does not produce a healthy version of folic acid but an incomplete version called inoglutamate. The liver will create inoglutamate from histidine if there is not enough methionine to do a proper job. When methionine is low, folate becomes trapped in the liver. This trapping of folate can also occur with a B 12 deficiency (Braverman 90).

Methionine is able to lower histamine levels in the body and as such it is helpful for people with histamine issues in the body such as asthma and allergies. Issues such as chronic pain due to inflammation can also be aided by methionine supplementation. Another circumstance that can cause the body to be extremely high in histamines is if someone is suffering withdrawal symptoms from drugs such as heroin, amphetamine, or even barbiturates (Sahley 60). Methionine's ability to lower histamine can help alleviate withdrawal symptoms.

Histamine levels also tend to be high in the brains of schizophrenic patients. There has been success at treating people with schizophrenia with methionine

supplementation. This tends to work best with people who also have depression in addition to schizophrenia.

As a methyl donor, one of the most important things that methionine contributes to making is S-adenosyl-L-methionine or SAMe. This compound is made of methionine and adenosine triphosphate (ATP). It works as an antidepressant that has been proven to be as effective as some major pharmaceutical antidepressants. However, SAMe is not recommended for people with a history of mania or bipolar disorder (Sahelyt 61).

As is standard with most amino acids, methionine is found in dairy and meat sources. However, sunflower seeds also have a very high amount of methionine. In general though, most plant based foods are very low in methionine.

Ornithine

- Urea Cyclor - Liver lover

Ornithine is a nonessential amino acid that is made from arginine. This occurs during the urea cycle. Ornithine is the precursor for proline, glutamic acid, and citrulline. Citrulline is made when ornithine is combined with ammonia and carbon dioxide. Citrulline is able to make arginine, which creates a perpetuating cycle with arginine and ornithine (Braverman 148).

While ornithine and citrulline are very similar to arginine, and in some cases may even be used interchangeably, ornithine and citrulline are different in that they are not involved in the makeup of any of the body's proteins. Ornithine's primary role deals with the metabolism and removal of ammonia from the body. This important role in the urea cycle makes ornithine a valuable metabolizing amino acid.

In addition to metabolizing ammonia, ornithine stimulates the release of growth hormone from the pituitary gland. Some athletes will supplement ornithine with arginine and carnitine since combining these amino acids is believed to stimulate enough growth hormone to further stimulate muscle growth. However, too much growth hormone in the body can have some negative consequences. Prolonged high doses of ornithine can cause irreversible enlargement of joints. It can lower the pitch of the voice and even cause a type of diabetes that is instigated from the pituitary gland. Again, balance of amino acids is very important. Since ornithine plays a role in the stimulation of human growth hormone, it is important the children should not have an excess of ornithine until they are fully grown.

Ornithine can help wounds heal and promote the regeneration of the liver. A compound called ornithine alpha-ketoglutarate or OKG is necessary in the body for wound repair and in times of extreme stress. This could be after a surgery or a burn injury or whenever the catabolic (breakdown) system of metabolism is active in the body. Catabolic states stimulate the body to breakdown proteins in order to find and use the necessary amino acids for repair rather than use them from the diet (Sahley 64). OKG is able to block catabolism from becoming detrimental and it stimulates the anabolic (building) aspect of the metabolic cycle. This anabolic action is necessary for the body to repair and rebuild.

Phenylalanine

-Pain Reliever -Depression Lifter

Phenylalanine is an essential amino acid that is known for being the precursor of many important neurotransmitters in the brain. It is highly concentrated in the brain. It is found in brain proteins and in both white and gray matter. Gray matter is what the cerebral cortex is composed of: the furrowed “brains” that cover the cerebral hemispheres. Gray matter is composed of nerve cells and their dendrites. White matter, on the other hand, is the part of the brain that connects the brain and the spinal cord and also the two hemispheres. It is a nerve tissue made up mostly of nerve axons.

Phenylalanine is metabolized in the liver and in fibroblasts by phenylalanine hydroxylase. In order for this enzyme to be able to manufacture phenylalanine, it must have sufficient amounts of B 3, B 6, a version of B 9, iron, copper, and vitamin C (Braverman 24). This is another clear example of the importance of healthy vitamin B levels in the body in order for amino acid metabolism. Phenylalanine itself then can metabolize into other neurotransmitters. The phenylalanine pathway is:

phenylalanine-tyrosine-dopamine-norepinephrine-epinephrine.

Phenylalanine can also be converted into a compound called phenylethylamine, the substance in chocolate that may trigger the release of endorphins. Indeed, phenylalanine is an important amino acid for forming feelings and experiences in our brains.

Phenylalanine is the raw material that produces many substances responsible for nerve impulse transmission in the brain. These nerve impulses stimulate mood in

individuals. Important mood influencing neurotransmitters such as norepinephrine and epinephrine are directly made from phenylalanine and rely on adequate amounts of this essential amino acid for healthy stable mood expression. Adequate amounts allow the brain to feel positive and uplifted, alert, and ambitious. Most people who suffer from depression are indeed deficient in phenylalanine (Sahley 65).

While tyrosine is often recommended for improving mood and depression, it is believed that phenylalanine is preferred since it is both more readily absorbed and also contributes to the manufacturing of additional neurotransmitters. But both tyrosine and phenylalanine will increase norepinephrine in the brain. Since many antidepressants work on the brain by influencing the level of norepinephrine, supplementing with amino acids may be a good replacement for pharmaceutical drugs. However, it is very imperative to work with a natural health care professional with this rather than self-diagnosing and self-dosing especially if the person is taking other medications.

Being well connected to the brain and central nervous system, phenylalanine plays a role in nervous reactions. Its derivative norepinephrine is excreted at the endings of sympathetic nerves. Thus it is able to stimulate the fight/flight/flee response of the body. When the body is in a state of stress, the adrenal glands are under great pressure to produce epinephrine and norepinephrine and this can over tax the adrenals and lead to a depletion of these important neurotransmitters. When this happens, the individual will often become stressed and depressed in ways that tend to manifest as panic, anxiety, fear, and uncertainty.

The left handed rotation version of amino acids, laevo, is most typical when referring to amino acid supplementation. The version of phenylalanine found in animal

proteins is the left handed, l-phenylalanine version. In version found in plant material is the right handed or dextro version. In the body, this right handed version is translated into the left handed version for assimilation. However, phenylalanine also has an additional version. It is called racemic and is an equal mixture of both the laevo and dextro version, dl-phenylalanine or DLPA. DLPA is a unique version of an amino acid and it works very well with managing pain.

In 1978, a Dr. Seymour Ehrenpreis and his colleagues at the University of Chicago Medical School published a paper on the use of DLPA to control pain. Before this, all studies were focused on the dextro version of phenylalanine, not the racemic version. For their study, Dr. Ehrenpreis selected people with a variety of pain problems whose commonality was that they had tried other pain management programs that had proven to be unsuccessful. There were a variety of different pain issues from whiplash to arthritis. They found that treatment of DLPA provided quick and lasting pain relief. Within one to four weeks, patients experienced relief and this continued after treatment stopped for about a month. Patients experienced no negative effects from DLPA (Chaitow 54)

Further research of DLPA has found that it is able to inhibit the enzymes responsible for the breakdown of endorphins. This allows the pain-relieving aspect of endorphins to last for much longer. So DLPA is not the component that reduces pain, but it is instead the vehicle by which the body's natural ability to produce pain-relieving substances is supported. It also does not interfere with the body's natural pain communication response, which is of benefit since the protective defense mechanism of pain in the body is not compromised.

Those that suffer from chronic pain tend to have low levels of endorphins in their cerebrospinal fluid. Using DLPA with people with arthritis has shown to be highly effective. It has also been very helpful for low back pain, joint pain, migraines, and even menstrual pain. With chronic conditions, many people are able to only need to take DLPA for one week a month and experience pain relief. Some need to stay on a regular regimen. But since both the dextro and leavo versions of phenylalanine are basic components of the body's chemistry, there is no negative effect, addictions, or health issues that arise from using this amino acid for pain control. In fact, it is most effective and preferable to the slew of narcotics on the market.

In addition to its pain-relieving and depression-fighting abilities, phenylalanine is excellent at improving mental states overall. It can alleviate the mental and emotional strain of menstruation that some women struggle with. It can also alleviate cravings associated with caffeine, carbohydrates, alcohol, cigarettes, and other addictive substances. Phenylalanine can also enhance the effects of stimulants such as caffeine and herbs that have stimulating properties (Braverman 32).

As a general rule, supplementing with phenylalanine is safe. However, if there is an overall deficiency of all amino acids, the balance can be thrown off. Maintaining a healthy body balance of amino acids will prevent any sort of toxicity from ingesting too much phenylalanine.

There is, though, a contraindication for phenylalanine and that is if the person is taking monoamine oxidase inhibitor (MAOI) antidepressants. Both phenylalanine and tyrosine can form a substance called tyramine. Some tyramine can be formed when dopamine is synthesized but some tyramine can also be made directly from tyrosine.

For people that are on MAOI inhibitors, tyramine can cause migraine headaches and severe problems with hypertension. In fact, it is often recommended that if someone is simply prone to migraines that they avoid foods that contain tyramine. In general the types of foods that contain tyramine are those that are aged, dried, pickled, preserved, fermented, cured, or cultured. These foods contain enzymes that can act upon the body's tyrosine and turn it into tyramine (Braverman 30).

As with most amino acids, meats and eggs are a good source of phenylalanine. However, there are many plant based foods high in this amino acid also. Bananas, avocados, almonds, lima beans, soy, peanuts, sesame seeds, and brown rice all are good sources for phenylalanine. This is beneficial for vegetarians who often struggle to consume adequate amounts of essential amino acids in non-meat food sources.

Proline

-Collagen creator

-Structure supporter

A non essential amino acid, proline is able to be synthesized by the body. It is the third most abundant amino acid in the body, outweighed only by glutamine and alanine. Almost every protein in the body contains proline and about half of all the body's proline is contained in collagen alone. Although proline is required through diet, amniotic fluid does contain proline. During pregnancy, the levels of this amino acid do not change. In childhood, the levels of proline in the body are quite small and insufficient to support growth and as such is considered essential.

Proline is synthesized by the breakdown of two amino acids: glutamic acid and ornithine. Glutamic acid catabolism signals the brain to ready the liver for proline production. Simultaneously, ornithine catabolism prepares the cells for growth, of which proline is an important constituent. So essentially the building of bone and muscle by proline relies on the proper metabolism of these two other amino acids. This metabolism is only made possible if enough B 3, B 6, and vitamin C are present in the body to support the conversions. If the body is low in vitamin C, proline will not be formed effectively and therefore collagen will not be made in adequate supply.

A possible sign that the body is low on vitamin C (and therefore be low in collagen production) is a high amount of hydroxyproline. Hydroxyproline is the waste material or catabolic product of proline. If there are elevated levels of this waste material, it is an indicator that collagen and bone are breaking down in the body. This is true in cases of osteoporosis. In fact the primary test to measure the rate of bone breakdown deals with hydroxyproline. One of its derivatives is telopeptides. These are

small breakdown parts of bone that can be measured in the urine to establish if osteoporosis treatments are proving successful or not.

In addition to maintaining collagen, proline is also important in maintaining joints, tendons, and ligaments, maintaining the muscle of the heart, and assisting in healing wounds and cartilage (Braverman 183). Because of its role in collagen synthesis, proline is often found in anti-aging beauty products to reduce the sign of wrinkles. These products tend to also contain vitamin C to ensure that the product is assimilated.

Proline is found in high concentrations in foods that are high in proteins. While this does of course include meat proteins, dairy proteins actually contain higher amounts of proline, which is unusual. This is good news again for vegetarians but also for avid cheese lovers. Of course, keep vitamin C levels high so that proline can properly be absorbed and utilized.

Serine

-Crazy causer -Cell container

Serine is a nonessential amino acid. It is formed from the amino acids glycine and threonine but this synthesis requires vitamins B3, B6, and B9 to make the conversion. Serine is highly reactive and is found in the cell membranes of all cells acting as a stabilizer (Braverman 223). Serine is required for the body to form necessary ingredients for neurotransmitter formation such as choline (vitamin B factor) and phospholipids. Serine is also necessary to help manufacture purines and pyrimidine, the essential components for DNA formation. In addition, it helps to form antibodies and immunoglobulins, making it important for immune function.

Serine has a working relationship with carbohydrates. It can be converted to a compound called pyruvate which assists in the breakdown or catabolism of carbohydrates to be used as an energy source. Pyruvate is also involved in the transformation of glycogen to glucose during gluconeogenesis, the formation of glucose from non carbohydrate sources. Additionally, serine can combine with carbohydrates for the purpose of building important structural proteins such as enzymes and hormones (Braverman 224).

A component of serine metabolism is phosphatidylserine or PS. While serine is found in all cell membranes, PS is particularly found in cell membranes of the brain and also in the hippocampus, the memory center of the brain. PS plays a role in memory and alertness and also in assisting the aging brain. With age, the brain experiences changes in structure and biochemical balance. Some of these changes include a loss of synaptic connections, decrease of neurotransmitter formation, and changes in the

lipid makeup of cell membranes. Supplementation with PS has been found to improve the state of mild to moderate brain deterioration. It has even been shown to improve early onset Alzheimer's (Sahley 69). There has also been success with using PS to help treat depression.

In addition to its influence to improving brain function, serine can also have a negative effect on the brain if unbalanced. Extremely high levels of serine have been found in those who suffer from psychosis. Many psychosis patients also have a deficiency of B 6 which is necessary for amino acid synthesis. Serine is also found in high concentrations in those with schizophrenia. It is suspected that either the body is producing too much serine or that the proper catabolic action of serine is not properly being carried out and thus it remains in high concentrations (Braverman 229).

Another interesting correlation has to do with children. High serine diets in children can cause a retardation of growth. Many poor quality meats such as lunch meats and sausages contain very high concentrations of serine. Supplementation of B6 helps to prevent this type of stunted growth (Braverman 227). Yet it calls into question the quality of childhood development for both growth and mental health for children in low-income areas fed poor quality food.

Meats contain the best amounts of serine. Yet cheeses, wheat, peanuts and soy are also good sources. Interestingly, these are also sources that tend to be types of foods that are allergens. It is possible for food allergies to manifest in the brain as cerebral allergies. In cases like this, the membrane surrounding the brain can swell and cause a host of symptoms from headaches to violence to aggression. Coupled with the high amounts of serine in lunch meats, this again calls into question the quality of

proper food for an individual and the quality of human it creates. It would be interesting to study the connection between allergies, serine content, poverty, violence, B vitamin deficiency and mental health.

Taurine

-Electrician for heart and brain

-Anticonvulsive

Taurine is a conditionally essential amino acid. Adults are able to maintain healthy levels but taurine is particularly important in infants and children. The developing brain requires four times more taurine than the adult brain does (Sahley 68.) In the brain, taurine is primarily located in the olfactory bulb (where taste and smell are concerned), in the hippocampus (the memory center), in the pituitary gland (the master gland), and also in the pineal gland (Braverman 131). Taurine also acts as a neurotransmitter and protects the membranes of the brain.

Outside of the brain, taurine is found in every cell and in great amounts throughout the whole body. It is found in the liver and kidneys, many glands such as the thymus and adrenals, the nasal membranes and salivary glands, and even in the mucosal lining of the digestive tract. But the highest concentrations of taurine are found in the heart, central nervous system, retina, white blood cells, and the muscle. Taurine has a very important job of helping facilitate the passage of sodium and potassium (and possibly calcium and magnesium ions as well) into and out of cells (Braverman 131).

For the most part, Taurine is synthesized from cysteine. In order for this metabolism to occur, there must be adequate amounts of B6. Taurine is a sulfur amino acid and as such a small amount of taurine can be metabolized directly from sulfate. Taurine works as an inhibitory amino acid much like GABA and glycine. This means it is able to suppress excitable neurotransmitters like norepinephrine. Taurine is also

used in the brain with calcium metabolism, and calcium plays a big role in helping the brain release neurotransmitters.

As an inhibitory amino acid, taurine has been found to be out of balance in those suffering from different neurological conditions. In children with developing brains, taurine acts as a suppressor before other suppressing systems have been fully developed. If a child is low in taurine, then it is believed that this lends itself to the predisposition of epilepsy. Taurine has anti convulsive effects while also being able to balance other amino acids. In epilepsy, the balance of other amino acids is remarkable disordered and taurine is able to bring them into a better balance (Chaitow 69).

Taurine's ability to be an anticonvulsant rests in its role in electrical activity. Found in areas of the body with high electrical activity such as the heart and brain, taurine's role in moving minerals through cell membranes influences the electrical charge of a cell. Additionally, taurine has an important job to balance nerve cell membranes that are continuously receiving and transmitting electrical information. It is important that there is stability in the nerve membranes so that they fire evenly and predictably, not erratically or too quickly (Braverman 137). Taurine assists with this electrical balance.

Another type of anti-convulsive ability taurine has is by improving the ticks and twitches of Tourette's syndrome. The spastic condition of this syndrome is associated with the nervous system firing in abnormal ways. Although it is important to make sure that the other amino acids and nutrients are in balance for a Tourette's patient, taurine will significantly help reduce the muscle spasms and rigidity (Sahley 71).

One of taurine's most important roles deals with the heart. Within the heart, taurine is the most concentrated amino acid, even more than all the other amino acids combined (Braverman 133). It helps with the ability of the heart's muscle to contract and thus plays a role in heart rhythm. As in the brain, taurine helps calcium metabolism in the heart as well, which influences the nerve impulses responsible for rhythm. Calcium is a "stimulating" mineral much needed to keep cells and systems working energetically.

If the body experiences high states of stress that lead to a heart attack, the amounts of taurine in the heart increase even more. After the heart attack, the levels decrease significantly. So much so that it can drop well below a normal amount which can cause the heart to struggle to resume a proper rhythm (Sahley 69) . For congestive heart failure, taurine is able to significantly help the body repair by ridding the body of excessive sodium and water, basically acting as a diuretic. Taurine also helps with the electrical balance of the heart. Being involved in the sodium/potassium balance, taurine helps maintain the proper balance of potassium inside the heart cells. If potassium levels decrease too much, this can lead to instability of the electrical actions of the heart (Sahley 70). Taurine helps maintain this important balance. In some countries like Japan, taurine is the number one treatment for all types of heart issues.

Taurine is also present in the retina of the eye. Interestingly, this often affects pets. Cats and dogs, like humans, require taurine to maintain healthy retina. Unfortunately, most commercial pet food is deficient in taurine and this can lead to degenerate info the retina of the eye. For Fluffy, this can mean blindness. If a pet's food does not contain taurine, it is important to supplement with raw fish or other

meats. Organ meats such as liver and kidney can be inexpensive ways to supplement this amino acid for them.

Humans do not suffer taurine related blindness, but taurine deficiencies will influence the health of human eyes. The light-sensitive cells of the eye are protected by the lens of the eye. But the lens can be easily damaged with UV radiation, cigarette smoke, air pollution and other environmental pollutants and toxins. Oxidation or degradation of the lens is believed to damage the proteins of the lens and lead to cataracts. Supplementation of taurine with zinc can slow the development of cataracts (Braverman 138).

Taurine is present in the master gland, the pituitary gland, and also in the pineal gland. Although the role of taurine in these glands is not fully understood, it does have a clear connection to light exposure. The pineal gland itself is pea size portion of the brain the is involved in the body's reaction to dark and light. It is believed to play a role in melatonin production and sleep/wake cycles. Exposure to natural light has long been understood to be an important part of the function of the pineal gland. When the body is exposed to natural light or full spectrum light, taurine begins to build up in the pineal and pituitary glands. When the body is exposed to synthetic artificial lighting, especially for long periods of time, the concentration of taurine drops dramatically. Synthetic light does not contain ultra violet light, that is the highest frequencies of the light spectrum (Chaitow 70). While the correlation is not clearly understood, the connection of taurine levels to healthy light exposure to these important cranial glands is clear.

Since taurine is a conditionally essential amino acid that is essential to newborns, it is important that newborns receive proper amounts of taurine. The best way to ensure that a baby is getting healthy doses of this amino acid is by breastfeeding. In addition to the other benefits and nutrition of breastmilk, taurine is supplied in proper doses by the mother's milk. Infants fed formula are regularly found to be deficient in taurine. In the mother's body, taurine increases the hormone prolactin, which signals milk production in her body. So a healthy balance of taurine in the mother is important for baby as well (Braverman 134).

For adults, taurine is not generally found in food sources. It does occur in organ meats, particularly brains, but since these organs can be toxic to eat, it is not generally recommended. For someone needing additional taurine, supplementation is the best route.

Theanine

- The Amino Om

Theanine has only recently been brought to the forefront of amino acids. And even so, it is not generally listed on most lists of amino acids. However, it has many benefits and is worth mention. This amino acid is non essential.

In 1949, Japanese chemists discovered theanine. It was found in green tea leaves. This tea has been consumed for thousands of years and is especially important to asian cultures. Studies of the benefits of green tea have been going on for decades and green tea is commonly considered a heart healthy beverage high in antioxidants. So the discovery of an amino acid in this plant is very interesting.

Theanine plays a role in creating GABA and also influences dopamine and serotonin levels. Dopamine is the feel good chemical of the brain and serotonin improves mood and pain levels. As such, theanine can bring a sense of well being and calm.

Very interestingly, theanine plays a role in brain waves. There are four main types of brain waves: alpha, beta, delta, and theta. Theta waves occur when someone is very relaxed and about to doze off. Delta waves occur during deep sleep. Beta waves are the wakeful, alert waves. During beta, the body can experience stressed states and increased heart rate, essentially the manifestation of the sympathetic (fight/flight/flee) nervous system. However, in alpha state, the brain waves are wakeful but relaxed. This is the state that is achieved through states like deep meditation. In alpha state, the body's parasympathetic (rest/digest) is able to turn on and healing can occur in the body since the body and brain are less susceptible to stress. Meditation and the

alpha brain waves that are a part of it, is where we can find transcendental healing on all etheric levels and layers of the physical and energetic body.

Every time your mood changes, your brain waves change. Throughout the day, you can experience many different brain waves. Theanine is able to help the body experience alpha brain waves. After ingesting theanine, the body begins to relax, the muscles relax, mood mellows, all indicating that alpha brain waves are beginning. A person slows down but does not feel sleepy.

In the brain, theanine converts to GABA and as such will assist with feelings of panic and anxiety. When one experiences panic or anxiety, messages from the limbic brain or reptilian brain flood the cerebral cortex, the decision making area of the brain. Panic happens when this flow of information from the limbic brain does not stop and instead overwhelms the cortex and causes feelings of panic. GABA is able to slow down these messages so that panic does not happen.

As a mood stabilizer and brain calmer, theanine is excellent in being the amino acid of om. Green tea of course is the best source for theanine, but supplementation is very useful. Depending on the dosage, someone may have to drink 4-5 cups a day of green tea to consume a high enough amount to really use it as a supplement. But green tea capsules and extracts are available (Sahley 74).

Threonine

- Thymus lover - Immune supporter

Threonine is an essential amino acid but it is not well known. This amino acid breaks down into glycine and serine but also into glucose. The highest concentrations of this threonine are found in the heart, skeletal muscles, and central nervous system (Sahley 74). This amino acid is a building block for proteins especially tooth enamel, collagen, and elastin. Threonine directly influences the thymus gland. It promotes the growth of the thymus gland and therefore boosts immune function. There are many studies with rat and mice that point to the presence of threonine for proper immunity. This specifically applies to the product of antibodies.

Deficiencies of threonine can cause symptoms of irritability or of being “difficult” in people. Proper threonine levels promote mental stability and balance especially with agitated depression or manic depression (Braverman 204). It is considered an essential component to mental health and wellness. Threonine is helpful for digestion. Threonine helps other nutrients of the body be better absorbed. It also helps improve indigestion or other intestinal issues (Chaitow 56). It also helps the body break down fats. This is particularly helpful for the liver and as such threonine is important for liver health and function. Fatty liver disease, which is often caused by diets high in fat and low in protein, can be healed with threonine.

Threonine is found in most animal proteins and also dairy products. Additionally it is found in decent quantities in seaweed, seeds, nuts, beans, and soy. Vegetarians tend to be deficient in this amino acid and should choose supplementation to avoid imbalances in the body.

Tryptophan

- Mood balancer - Sleep Maker

Tryptophan is an essential amino acid. It breaks down into the neurotransmitters serotonin, melatonin, and niacin. It is considered an aromatic amino acid. The metabolism of tryptophan is complex and includes many different pathways. The main enzyme involved in tryptophan metabolism is hydroxylase. This enzyme is responsible for breaking down all the aromatic amino acids which includes tryptophan, tyrosine, and phenylalanine. Of course, it is necessary to have enough supply of vitamin B6 for this transformation to occur. But tryptophan specifically relies on adequate supplies of B6 in order for its metabolism to occur. Tryptophan also has an interesting relationship with B3. Niacin, or B3, works with B6 and glutamine for tryptophan metabolism. But B3 can also be made from tryptophan. In these cases, tryptophan acts as the “vitamin” and B3 becomes the metabolite (Braverman 56).

The most notable or popular of tryptophan’s metabolites is serotonin. Serotonin allows for feelings of calm, control, and relaxation. But tryptophan also can turn into 5-hydroxytryptophan or 5-HTP, and melatonin. In fact the metabolic pathway is:

tryptophan - 5HTP- serotonin

Many years ago, there was a ban on tryptophan and during this time, a lot of research was put into 5-HTP and melatonin. In 1989, tryptophan was implicated in an outbreak of a rare autoimmune disease called eosinophilia myalgia syndrome or EMS. This rare disease causes swelling of the arms and legs, numbness, fever, severe muscle pain, and possible death. The evidence of this outbreak was found to be a contaminated supply from a Japanese manufacturer. Before this time, tryptophan was deemed very

safe, but this contaminated product caused a lot of fear around this amino acid.

Tryptophan was even pulled from sale for six years.

The public responded very antagonistically towards tryptophan and the many years of research and evidence of its value were ignored during this scary time. It is now known that tryptophan is safe but what is even more important is the balance of amino acids in the body. It has been shown since then that a tryptophan deficiency can cause some of the symptoms of EMS such as the muscle aches and pain. It is even thought that some of the people suffering from the contaminated product were already unable to properly metabolize tryptophan. But studies now show that excluding tryptophan from amino acid supplementation is not wise and cause many imbalances in the body. Tryptophan was available to the public again in 1996 and since then it has regained its reputation of being important in the body's balance (Braverman 54).

Tryptophan's relationship with serotonin is popular even to people who know little of amino acids. It is often talked about around thanksgiving, since turkey and many thanksgiving foods contain high levels of tryptophan. It is popularly known to be the component that makes people sleepy after the thanksgiving meal. But tryptophan's connection with serotonin is a bit more complex than a post-feast nap.

Tryptophan has a bit of a challenge to increase the rate of serotonin in the brain. In order for tryptophan to become serotonin, it does not simply pass through the intestine for absorption by the body. Instead, it has to compete with five other amino acids: tyrosine, phenylalanine, leucine, isoleucine, and valine. Each of these five amino acids can also pass the blood brain barrier and tryptophan must compete for entrance.

The only way for brain levels of serotonin to increase is for tryptophan levels to be proportionally larger than its competitors to pass into the brain (Sahley 77).

One of the few substances able to pass the blood brain barrier, tryptophan is important for mental health. When there is a deficiency of tryptophan, the levels of serotonin in the body drop. This generally happens during periods of stress and can cause depression, anxiety, insecurity, insomnia, hyperactivity, and even pain (Sahley 76). Children and adults with hyperactivity generally have low levels of serotonin, and low levels are often found in those with aggressive behavior. In fact, aggression is often one of the first signs of low tryptophan levels. Supplementation with tryptophan and B6 can often improve states of aggression.

Children with mental retardation have also shown to have disorders in tryptophan metabolism. Often treatment with just vitamin B6 is sufficient to help improve this. Tryptophan and vitamin B6 deficiencies can often appear as similar symptoms. Tryptophan metabolism is also noted in people with pyroluria, an imbalance in hemoglobin metabolism. It is thought that the main reason in this case is because tryptophan is necessary to allow for the absorption of zinc in the body and those with pyroluria require extra zinc supplementation (Braverman 60).

Tryptophan also plays an important role in sleep. One reason a person may have difficulty falling asleep is from low serotonin levels. But tryptophan itself has for a long time been considered the most reliable natural sleep compound ever (Braverman 67). This may have a part to do with the fact that tryptophan metabolizes into melatonin. But supplementing with melatonin is not the same as supplementing with tryptophan. Self-dosing with melatonin can result in sedating effects. But tryptophan

has been shown in many studies to shorten the length of time it takes to fall asleep and it lengthens the time asleep. It seems to be most effective to take a tryptophan supplement before bed with a snack that contains carbohydrates for best results.

Tryptophan's ability to induce deep sleep when taken before bed corresponds with its role in the Circadian rhythm. Since tryptophan is not a sedative that induces sleep when taken throughout the day (Thanksgiving aside), but it is most effective before bed, this implies a connection to its presence in the brain influencing the sleep/wake rhythms. These circadian rhythms are very important not just for physical and mental health, but they also influence the utilization of amino acids by the nervous system (Sahley 77). This rhythm is necessary for the uptake of many of the body's substances.

Of course melatonin has a clear connection to this sleep rhythm. Tryptophan metabolizes to melatonin through two different enzymes in the pineal gland. Melatonin is both an amino acid and also a hormone but it is most well known for its role in the circadian rhythm. The levels of melatonin in the body rise and fall over a 24 hour biological rhythm that is governed by light and dark in the surrounding environment. In the body, melatonin production begins around 8 pm and there is another peak around 4 am. In the morning, melatonin levels in the body are very low.

Melatonin also has additional benefits. It plays a role in depression and can lower blood pressure. There is evidence that melatonin can slow the growth of cancers. It can alleviate migraine headaches associated with menstruation and even help with psychiatric disorders. However, it is important to note that the body's melatonin reserves are threatened by the modern world. Today we are exposed to

nearly constant low level electromagnetic frequencies. Studies suggest that this exposure can damage the pineal gland and therefore disturb melatonin secretion. So adding melatonin to a supplement plan may be wise for some who are suffering from this environmental toxin (Braverman 77).

Another aspect to tryptophan is its role in managing pain. There is an area of the brain called the nucleus raphe magnus and it is a primary pain-inhibiting area of the brain. This part of the brain relies on serotonin and its precursor tryptophan to function properly. When there is enough of these two compounds, then this area of the brain can work efficiently in reducing the pain of certain headaches, dental pain, and even cancers.

After tryptophan was banned from the market, there was a rise of interest in 5-HTP and it was studied extensively during this time. Some may argue that it is easier for the body to utilize since it is one step closer to serotonin than tryptophan is. But it is not beneficial to everyone since many people do not respond to it when it is used as an antidepressant (Braverman 74). Additionally, it is extremely expensive. To create 5-HTP supplements, it is extracted from Griffonia seeds which come from a plant native to Africa. Perhaps a better alternative is to ensure enough tryptophan is consumed and enough B6 to metabolize it.

Although we often talk about the high-tryptophan foods at Thanksgiving, the truth is that tryptophan is not found in very high concentrations in any particular foods. In fact, it is the least abundant amino acid in foods. Meats do contain a decent amount as do some cheeses, eggs, and almonds. But if additional supplementation of tryptophan is required, an actual supplement will most likely be the best alternative.

Tyrosine

-Stress buster

-Addiction fighter

-Depression lifter

Material is conflicted about the nature of tyrosine as essential or non essential. Tyrosine is synthesized in the body from phenylalanine and phenylalanine is an essential amino acid. So in a way tyrosine is both essential and non essential. Perhaps the importance is that the body has adequate amounts of this amino acid for health and nutrition balance.

Tyrosine is not found in large amounts throughout the body in part because it is so easily metabolized from phenylalanine. Of course this metabolism requires adequate nutrition such as vitamin C, a couple versions of B 3, and copper. However, most tyrosine is considered to be in brain tubulin. This is an intracellular protein that is necessary for neuron structure. Neurons are nerve cells that fire electrical impulses in the brain. This impulse releases neurotransmitters. In the brain, there is a relatively small amount of tyrosine compared to other amino acids that are in the brain. However, there is a significantly high amount of tyrosine in muscle.

Tyrosine is the precursor to thyroid hormones, adrenocortical hormones, and to the neurotransmitter dopamine. Tyrosine is also synthesized into melanin, the pigment that gives skin its color. Tryptophan is also part of the metabolic pathway from phenylalanine to norepinephrine and epinephrine. It's relation to these neurotransmitters causes it to often be used to enhance them since it is a step closer than the original phenylalanine and therefore metabolized and utilized by the body much quicker (Sahley 80). For this, tyrosine is used to improve depression. However,

it is contraindicated if someone is taking MAO inhibitors or has schizophrenia, just as with phenylalanine.

In addition to alleviating depression, tyrosine can help dysthymia. Dysthymia is a mild form of depression that affects some 25-50% of the population at any given time. Use of tyrosine, especially over a long time, can help to promote a sense of well-being. This is particularly beneficial for healthy people who are simply over-stressed. This can also benefit people over age 50 who experience “blah” days and just don’t feel all that great. While many of these types of people tend to start taking antidepressants, supplementation of tyrosine instead is incredibly effective.

Another substance that is used to help dysthymia is dehydroepiandrosterone or DHEA. DHEA is an adrenal steroid hormone found in the bloodstream and the brain. Tyrosine stimulates production of the adrenal hormone and DHEA functions very similarly. As people age, levels of DHEA drop significantly and is believed to be associated with many aging symptoms including senility. This is a result of the adrenals glands slowing down. Just as women experience a slowing down in the ovaries, menopause, and men experience a slowing down of the testicles, andropause, the same slowing down of the adrenal glands occurs. Supplementing with the adrenal gland’s hormone, DHEA, improves the conditions of slowing down adrenal glands (Braverman 41).

Tyrosine is very effective at treating stress. While tyrosine does increase levels of epinephrine and norepinephrine and dopamine, all factors that can improve depression, they also work to improve the body’s experience of stress. Tyrosine helps the body physiologically cope with stress and at the same time boosts the body’s

adrenaline stores (Braverman 47). In times of stress, the adrenal glands can become extremely exhausted and cause “burn out”. By refilling the tanks of these glands, the body’s burden is made lighter.

In fact tyrosine is so beneficial to helping the physical body cope with stress that the US military has taken an interest in the properties of this amino acid. Using a stimulant that is in the same family of tyrosine called modafinil (a pharmaceutical) the military has used it on pilots flying to Afghanistan to deliver troops. Generally the stresses imposed on people in the military end in loss of manpower due to extreme stress and this derivative of tyrosine alleviates that. Things such as shell shock, combat fatigue or “battle stress” are terms used for many years to describe the state of many soldiers experiencing the horrors of war. Tyrosine supplementation may prove to be an effective and safer alternative to other stimulants such as amphetamine.

Another important role for tyrosine is its ability to help with substance abuse. Use of this amino acid has been shown to help cravings associated with cocaine, cigarette, and alcohol withdrawal. Formulas that contain tyrosine can act similarly to opiates that deliver feel-good chemicals to the brain. Tyrosine can help eliminate or delay relapse. It is possible that if enough tyrosine is present at an early stage that substance abuse may be avoided altogether (Braverman 49).

Tyrosine also helps treat attention deficit disorder, ADD. Perhaps this is because tyrosine is beneficial in instances where amphetamines have been useful. And more often than not, children diagnosed with ADD are put on amphetamines at a very young age. Tyrosine supplementation is a much safer way to improve the brain chemistry of young children with a supplement that is non-addictive and has no negative effects.

Additionally, tyrosine can improve cognitive performance in the elderly. As people age, levels of tyrosine decrease as do other substances in the body. Alzheimer's patients have a notable deficiency of tyrosine. To add to this, the brain's voltage and thus its ability to fire and send nerve impulses decreases as well. In Alzheimer's patients, two major neurotransmitter systems are very damaged: the choline and tyrosine systems. It goes to follow that tyrosine supplementation can help improve Alzheimer's symptoms quite dramatically (Braverman 39).

There are certain conditions that have a marked deficiency of dopamine. These include narcolepsy (the sudden and uncontrollable desire to sleep), Parkinson's disease, and some depression. Specifically dopamine-dependent depression or DDD. This type of depression is characterized by depressed individuals who have a disinterest and lack of emotions coupled feelings of moral pain or feeling culpable for things. They also experience sleep disturbances from rapid eye movement (REM).

Researchers in France suggested that people with DDD and narcolepsy would benefit from tyrosine. Their studies found that tyrosine supplementation improved the conditions of both DDD and narcolepsy. For DDD, they found a remission of depression and improved sleep patterns. For their narcoleptic patients, the most immediate result is the improvement of cataplexy, loss of muscle tone. And within a month all patients were free from the major symptoms of narcolepsy including sleep attacks and paralysis, hallucinations, insomnia and depression (Braverman 44).

Food sources for tyrosine are the same as with phenylalanine. Very little is found in any cereal grains, vegetables, fruits, and even oils. Most tyrosine content is found in meats, dairy products, almonds, pumpkin and sunflower seeds, and beans.

The Incredible Edibles

When choosing foods that are high in essential amino acids, there are some particularly excellent ones that supply a wonderful balance of many amino acids. One of the best sources for a balance of essential amino acids is eggs. First, eggs are low in dietary cholesterol. For many years the rate of heart disease and heart attacks has increased and cholesterol has been made to blame for much of this. Eggs are high in fat and as such they were treated as if they were the culprits to the cholesterol levels of Americans and to be avoided.

Since this time, the concept of good fats has become brought to the attention of the public. And eggs are considered to contain good fat. To a natural health professional, the presence of cholesterol in the body is not regarded as frightening. Cholesterol is needed to heal wounds. But the overconsumption of high cholesterol foods more in the American diet, specifically red meat, is problematic. Additionally, many people are not aware about eating according to their personal blood type and the average American choice of a hamburger or steak is not suited to everyone.

Even though they contain fat and cholesterol, eggs contain many heart healthy nutrients. Eggs are an excellent protein source that is easier on the body and the arteries than over consuming meat. And to add to that, eggs are a nearly perfect amino acid food. In fact an egg is more balanced in its amino acid content than a steak is and this balance allows for the body to utilize those proteins much easier. This easy to incorporate, make it a million ways, inexpensive food is a wonderful source for a balance of essential amino acids.

Another power food for amino acids is bee pollen. This tasty substance made from the hard work of amazing bees and contains a high amount of amino acids. Which particular amino acids can vary depending on which types of flowers were used to obtain the pollen, but this is just another delicious and nutritious way to keep amino acids in a balanced diet.

Of course, there must be a mention of Bragg's Liquid Aminos. Amino acids are literally in the name of this soy-sauce tasting condiment. Although there are many conflicting opinions of soy products today, soy still remains a great source of many amino acids. This plant-based option is a must for vegetarians and vegans who otherwise would be missing out on several important aminos in their diets.

Balance and Nutrition (And a Big Shout Out to Bs!)

By now, it should be pretty clear that amino acids are amazing and they deserve to be regarded as equally important to health as vitamins and minerals are treated. Even though amino acids are not widely studied and thought of, without them the body not only wouldn't function, the body wouldn't exist. Knowledge helps to strengthen our ability to care for ourselves and those around us. A working knowledge of amino acids, even if it is just basic, allows for an entirely new level of awareness and tools to apply towards healing and wellness.

A major theme throughout amino acid studies emphasizes the need for balance. When the body is out of balance, then there is the opportunity for disease to move in. Indeed the concept of balance is applied to all areas of natural health. Balance helps to keep things in homeostasis and allow for health and wellness. It is important when learning about amino acids to not simply run out and start self-medicating hoping for a quick fix for a particular ailment or condition. There is always a larger picture of balance that must be respected and maintained for health. It is best to work with your natural health care provider on an amino acid supplementation plan that works best with your individual body.

In addition to the proper unique balance of amino acids that your body needs is the importance of balance in other areas of nutrition especially vitamins. And even more specifically is the importance of B vitamins and vitamin C. Throughout this journey of amino acid discovery, B vitamins have taken a very important role. Some of the most mentioned being niacin (B3), pyridoxine (B6), folic acid (B9), cobalamin (B12) and choline (B factor).

Generally most people think of B vitamins in relation to how they can help energy levels and mood. This is true, but the reason they are able to lift mood and energy levels is because they are helping metabolize amino acids into the chemicals that give the brain these feelings. They are making neurotransmitters, membranes, muscle tissue, brains, and everything in-between. All amino acids are made from something and almost all amino acids are made into something else. These transformations are the vital part of the process that ultimately allow the body to experience what these amino acids can do and ultimately allow for people to live healthy and full lives. And more often than not, these transformations are only made possible with help from vitamins.

Of course most of these changes in the body would not be possible without our dear vitamin C as well. More than fighting the common cold, this powerful antioxidant is one of the most important ingredients in amino acid metabolism. For many amino acids, they can't go through any metamorphosis at all without vitamin C. Truly, this is a superstar for the world of amino acids.

Maintaining health is much easier to accomplish when the body is provided the tools and raw materials it needs in order to be healthy, wealthy, and wise. Vitamins, minerals, amino acids. The holy trinity of nutrition! Self-care includes caring for your body by not neglecting any of the important and necessary, even essential components it needs. Give yourself love, light, and balanced nutrition, and be well in the body you were given to enjoy on this earth.

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