

MD+ AMINO VERSION V

The Revolutionary, Research-Driven, Anabolic, Amino Acid Formula



Amino, the most advanced cutting-edge amino acid formulation on the market today, maximizes protein synthesis by providing you with a quick and potent boost of anabolic and anticatabolic hormones and amino acids.

The high systemic levels of amino acids and other synergistic ingredients provided by Amino has a direct effect on increasing protein synthesis, and at the same time increases systemic levels of the potent anabolic hormones and growth factors, including insulin, testosterone, growth hormone and IGF-I.

<https://metabolicdiet.com/product/amino/> - Revised October 4, 2021

Amino is formulated to maximize protein synthesis and is especially useful before exercise for minimizing protein catabolism during and after exercise for maximizing the anabolic effects of exercise and enhancing recovery.

As well, it can also be used to boost protein synthesis and energy metabolism anytime during the day, making it especially useful for those wishing to cut back on calories in order to maximize body composition by helping to decrease body fat while at the same time sparing muscle.

Formulated by Mauro Di Pasquale, M.D.



Dr. Di Pasquale is a licensed medical doctor, an author, a former world champion, a former professor at the University of Toronto, and actively involved in researching, writing, and practicing in the weight loss, fitness, body composition, sports performance, and fitness fields for over five decades.

Amino version V Supplement Panel

Supplement Facts:		Serving Size: 12 Tablets			
		Servings Per Container: 15			
	Amount Per Serving	% Daily Value*			
			Amount Per Serving		
			% Daily Value*		
Vitamin C (Ascorbic Acid)	200 mg	340%	L-Valine	700 mg	*
Vitamin E (as d-Alpha Tocopherol Succinate)	100 IU	333%	Taurine	500 mg	*
Vitamin D3 (Cholecalciferol)	200 IU	50%	L-Alanine	250 mg	*
Vitamin B1 (Thiamin HCl)	10 mg	670%	Glycine	250 mg	*
Vitamin B2 (Riboflavin)	10 mg	590%	L-Serine	250 mg	*
Vitamin B6 (as Pyridoxine HCl and Pyridoxal-5-Phosphate)	10 mg	500%	Ornithine Alpha-Ketoglutarate	500 mg	*
Vitamin B12 (Cyanocobalamin)	50 mcg	830%	L-Arginine Aspartate	500 mg	*
Biotin	50 mcg	15%	Citrulline Malate	400 mg	*
Calcium (as Calcium Phosphate)	1000 mg	100%	Potassium Succinate	400 mg	*
Chromium (as Amino Acid Chelate)	25 mcg	20%	Beta Alanine	400 mg	*
Selenium (as L-Selenomethionine)	25 mcg	35%	L-Carnitine	300 mg	*
L-Glutamine	500 mg	*	N-Acetyl-L-Cysteine	300 mg	*
L-Histidine	650 mg	*	Alpha Lipoic Acid	250 mg	*
L-Isoleucine	700 mg	*	Amino™ Proprietary Complex (APC) 4,950 mg		
L-Leucine	3000 mg	*	Glutamine Peptides (from Casein) (Glutamine, Proline, Leucine, Serine,		
L-Lysine	900 mg	*	Phenylalanine, Valine, Arginine, Isoleucine, Tyrosine, Tryptophan,		
L-Methionine	250 mg	*	Glycine, Aspartate, Threonine, Alanine, Histidine, Glutamate, Methionine,		
L-Phenylalanine	1200 mg	*	Lysine, Cysteine), Creatine Monohydrate, Carnosine, Coenzyme Q10,		
L-Threonine	900 mg	*	Adenosine Monophosphate (AMP)		
*Daily Value Not Established					
Other Ingredients: Stearic Acid, Modified Cellulose Gum, Magnesium Stearate, Titanium Dioxide, Hypromellose, Hydroxypropyl Cellulose, Silicon dioxide					

Amino version V

- 1. Maximizes protein synthesis and decreases muscle breakdown before and after training and anytime it's used.**
- 2. Enhances body composition and increases the loss of body fat.**
- 3. Improves both mental and physical performance.**
- 4. Maximizes the anabolic and fat burning effects of exercise.**
- 5. Supports and maintains musculoskeletal health**
- 6. Reduces inflammation**
- 7. Helps heal injuries by reducing catabolic influences and promote tissue rebuilding**
- 8. Enhances energy levels and recovery time for those who train hard and compete**

The information below on the new Amino version V is in draft form and will be expanded and revised over the next few months. For now, this latest information will give you the flavor of just what Amino will do for you in helping you achieve your health, body composition, and mental and physical performance goals.

Crucial Essential Amino Acid Mix

Amino version V contains:

- The mix of essential amino acids that in research studies have been shown to maximize post exercise protein synthesis.¹²
- High amounts of branched-chain amino acids (BCAA), which have been shown to stimulate protein synthesis before and after training. BCAA have also been shown to increase resistance to fatigue and enhance lipid oxidation (fat burning) during exercise in those who are glycogen-depleted.³ This means that Amino is especially useful for those who follow my phase shift diets in which pre-exercise glycogen depletion exists in the low carb phase. Studies have also recently shown that glycogen depletion prior to exercise enhances fat metabolism, speed and endurance.^{4,5,6} It's also my view that glycogen depletion before training, if you're on my phase shift diets, also enhances the effects of training on body composition and strength.
- The conditionally and non-essential amino acids that have been shown to be most used for protein synthesis in muscle (serving not only as direct substrates but also sparing the conversion of these amino acids from the essential ones). While the presence of essential amino acids is critical to protein synthesis, there is some evidence that lack of the nonessential amino acids can result in lower plasma levels of these amino acids⁷ which may ultimately compromise protein synthesis in situations where there is rapid growth.
- My Amino Proprietary Complex (APC), a proprietary blend of several ingredients, which along with other ingredients in Amino maximizes mitochondrial anaplerotic flux in the TCA cycle resulting in increased ATP production and increased energy availability for protein synthesis and other functions, including the formation of phosphocreatine.
- Measured amounts of several anapleurotic and other ingredients, including calcium alpha ketoglutarate, arginine aspartate, potassium succinate, citrulline malate, magnesium fumarate and adenosine monophosphate (AMP) that impact on TCA flux and which I feel, maximize mitochondrial metabolism, increase aerobic energy production, and enhance insulin and growth hormone/IGF-I secretion and formation.

One dose – 12 tablets contains:

A total of 19.5 grams of amino acids in the form of free amino acids, amino acid derivatives and metabolites, and peptides. The breakdown is as follows:

- **11.6 grams of Essential Amino Acids (EAA)**
- **6.3 grams, or over 50%, of the EAA are in the form of branched chain amino acids (BCAA) – over half of the BCAA is in the form of leucine.**
- **2.4 grams of the conditional amino acid glutamine**
- **.7 grams of the conditional amino acid arginine**
- **4.8 grams in total of non-essential and conditional amino acids, Krebs Cycle intermediates, and related compounds, including Alanine and Taurine.**

Besides the amino acid content Amino also contains several Ingredients that enhance the effects of the amino acids in Amino. This combination of ingredients is enough to make Amino the most effective amino acid supplement on the market today.

Amino, while formulated to be the ultimate post training supplement, can also be used at other times of the day. An increase in protein intake by itself has been shown to not only increase protein synthesis and decrease muscle breakdown but has also been shown to increase both aerobic and anaerobic performance.⁸ But Amino does much more than simply increasing protein intake.

Amino provides a square wave systemic increase in amino acids that translates into an increase in protein synthesis, which in turn keeps the body in an anabolic state. As such it's perfect as a snack between meals, especially if you're trying to reduce body fat.

Because of the way Amino is formulated, it's especially useful for anyone trying to maximize muscle mass while at the same time minimizing body fat.

The information below on the new Amino version V is in draft form and will be expanded and revised over the next few months. For now, this latest information will give you the flavor of just what Amino will do for you in helping you achieve your health, body composition, performance, and anti-aging goals.

Amino version V

Version V of Amino represents the ongoing improvement of the best amino acid supplement on the North American and International markets. Amino IV represents a new paradigm and is a quantum leap above all other amino acid products.

In keeping with the aim of maximizing protein synthesis and anabolic processes the formulation for amino has been improved, with more of some of the ingredients, and over a dozen new ingredients.

The new formulation further enhances various pathways involved in increasing protein synthesis, decreasing protein catabolism and increasing recovery.

For example, **vitamin D** has been added since this vitamin has recently been shown to enhance protein synthesis and have specific anabolic effects.

Branched Chain Amino Acids

The amount of **L-leucine** has been more than doubled since it's been shown that leucine has major regulatory effects on protein synthesis. Amino contains over 6 grams of branched-chain amino acids per dose (both free and in the form of peptides), with over half of it in the form of leucine.

High amounts of branched-chain amino acids (BCAA), which have been shown to stimulate protein synthesis before and after training. BCAA have also been shown to increase resistance to fatigue and enhance lipid oxidation (fat burning) during exercise in those who are glycogen-depleted.⁹

This means that Amino is especially useful for those who follow my phase shift diets in which pre-exercise glycogen depletion exists in the low carb phase. Studies have also recently shown that glycogen depletion prior to exercise enhances fat metabolism, speed and endurance.^{10, 11, 12} It's also my view that glycogen depletion before training, if you're on my phase shift diets, also enhances the effects of training on body composition and strength.

Also, while of the BCAAs leucine seems the most important, it's also paramount that the other two BCAAs also be present in the formulation since supplementation with leucine alone may have side effects due to impairment in the availability of valine and isoleucine. This is because the activity of the rate-limiting enzymatic complex in BCAA degradation, i.e., branched-chain alpha-keto acid dehydrogenase, is markedly stimulated by the presence of leucine or its keto acid, alpha-ketoisocaproate, which in turn decreases the availability of endogenous valine and isoleucine if they're not included in the formulation.^{13, 14, 15}

Glutamine, Glutamate, and Alpha-Ketoglutarate

Amino contains significant amounts of glutamine and glutamate, as L-glutamine, and glutamine peptides.

L-Glutamine (glutamine), the most abundant free amino acid in the body, is involved in multiple aspects of metabolism and signal transduction pathways. While some glutamine comes from dietary sources, most of the systemic glutamine is produced by skeletal muscle from alpha-ketoglutarate/glutamate and ammonia, and has several important effects in the body including its use as an energy substrate since the alpha-ketoglutarate (AKG) is a substrate of the Krebs/TCA/Citric Acid Cycle (the three are used interchangeably) and its formation increases TCA cycle flux and ATP formation.

As well AKG, either directly through the TCA cycle intermediates or indirectly through the formation of alanine formed in muscle via the alanine transaminase reaction. The alanine is then transported out of the muscle and to the liver to undergo gluconeogenesis and thus increase glucose availability.

The ammonia for these processes eventually comes from deamination of the branched chain amino acids (BCAAs – leucine, valine, and isoleucine) and under conditions of stress when more of the

BCAAs are used to produce needed alanine and glutamine, the result is a decrease in protein synthesis and the anabolic effects of exercise.

Glutamine has significant effects on body composition and performance as it favorably affects growth hormone and cortisol levels, protein synthesis, cell volume, muscle catabolism (inhibits it) and gastrointestinal and immune function.¹⁶¹⁷¹⁸¹⁹²⁰ It's used for energy by most cells in the body but especially by the GI tract, liver, kidney and the immune system. The process for energy production is by successive deamination of glutamine to glutamate, then to alpha-ketoglutarate that enters the TCA/Krebs cycle and through the oxidative phosphorylation forms ATP, the main energy source on which the body functions.

Glutamine is also used as a basis for the synthesis of the ATP molecule itself, nucleic acids (DNA and RNA synthesis and repair), other amino acids and proteins, glucose through gluconeogenic pathways, carbamoylphosphate, and other metabolites. As well glutamine increases glutathione, a powerful endogenous antioxidant that mitigates the counter-productive effects of exercise on excessive muscle damage without affecting the positive effects of exercise.

The interconversions, reactions, pathways and signaling that glutamine is involved in are complex and impacts many metabolic processes that are beyond the means of this information piece. As an example, glutamate can be used (besides conversion to glutamine) in an alanine aminotransferase reaction to produce alpha-ketoglutarate (AKG) and alanine or by the reverse reaction alpha-ketoglutarate can be aminated by ammonia or via a transamination reaction from other amino acids to form glutamate and pyruvate. The resulting alanine and pyruvate are involved in complex interactions and so the complexity of how glutamine affects metabolism soon increases exponentially.

For now, we'll simply cover some of the basics on glutamine dynamics, benefits, and what many people consider potential adverse effects from glutamine supplementation.

While normal levels of endogenous glutamine are sufficient under most conditions, at times, such as when the body is under stress, it's not enough. Depending on endogenous glutamine to supply the glutamine that the body needs under special circumstances including exercise, is like robbing Peter to pay Paul – using up needed carbon skeletons and amino acid precursors from muscle to make glutamine, thus impoverishing muscle tissue, because glutamine is more importantly needed elsewhere in the body for energy, to bolster immunity, and other purposes.

At times when endogenous glutamine resources are stretched beyond what's needed, a time when glutamine becomes an essential amino acid since not enough can be formed endogenously, glutamine supplementation becomes a necessity.

Supplementation with glutamine, optimally as a free amino acid, or as glutamine peptides for quick access when needed, and from whole proteins that contain high levels of glutamine to keep glutamine levels optimized for normal times, has many beneficial effects by allowing other tissues access to the glutamine they need to function optimally, and by increasing health, body composition (fat loss and muscle hypertrophy), and physical and mental performance.

Glutamine has both direct and indirect anabolic effects. Glutamine directly increases energy metabolism and protein synthesis. Indirect effects include decreasing the deamination of the BCAAs and other amino acids and thus keeping their levels higher in skeletal muscle. Increased levels of leucine, for example, has stimulatory effects on protein synthesis and inhibitory effects on protein degradation/muscle catabolism. Also, transitory increases in ammonia, by providing amine groups for

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the formation of various amino acids, has an inhibiting effect on skeletal muscle proteolysis/breakdown.

A recent paper found that glutamine supplementation improves some parameters of sport and exercise performance, and chronic supplementation appears to be of special importance for increasing tolerance to intermittent exercise, lowering feelings of fatigue, and optimizing recovery from muscle damage. Glutamine may also act as a relevant resource for rehydration during strenuous and prolonged physical activity.

Glutamine and Ammonia

Ammonia is produced in the body from several processes including amino acid (mostly from glutamine and BCAAs) and purine deamination.

As far as adverse effects, there are none from the use of several grams of glutamine before and after exercise. However, there is a long-standing misconception that glutamine supplementation increases ammonia to the point that it has a negative effect physically and mentally on exercise performance.

The basis of this often-repeated belief is that glutamine acts as an important energy source for various tissues, including the gastrointestinal tract, the liver and skeletal muscle. The successive deaminations from glutamine to alpha-ketoglutarate results in the formation of 2 molecules of ammonia (NH₃) and it's the potential ammonia accumulation that many feel may make glutamine supplementation counter-productive by increasing physical and mental fatigue.

The ammonia-fatigue theory is almost a century old (a paper published in 1922 first suggested the correlation between ammonia accumulation and fatigue²¹) and based on the link between exercise and muscle derived ammonia production with the results of studies where ammonia production was correlated with fatigue under pathological conditions in which increases in ammonia resulted in neuromuscular dysfunction.

This association was then falsely extrapolated to suggest that further increases in ammonia during exercise from glutamine supplementation results in fatigue and compromised exercise performance.

This ammonia-fatigue theory, especially involving glutamine supplementation, while hopelessly outdated, persists. But the fact is that a normal person without significant liver or kidney disease or genetic mutations that results in a deficiency of one of the six enzymes in the urea cycle, can keep in check, and even get beneficial effects from any ammonia formed during even the most extreme exercise or sporting event with or without the use of glutamine supplements.

It's been shown that the regular use of glutamine in sports that do not require continuous exertion for long periods of time, because of compensating mechanisms as ammonia levels rise, decreases systemic and skeletal muscle levels of ammonia rather than increasing it.²²

The decrease in ammonia is the result of adaptation responses to the increased glutamine breakdown including the suppression of synthesis of endogenous glutamine (thus sparing skeletal muscle BCAAs, and especially leucine and thus preserving the anabolic effects of intense exercise), elevating the expression of enzymes of the urea cycle, and priming both hepatic and renal systems to increase the disposition of ammonium.

In continuous, prolonged and strenuous exercise ammonium levels rise as exercise progresses but is easily kept in even with the use of glutamine supplements.

On the contrary physiological increases in levels of ammonia in healthy people during exercise can have significant ergogenic effects.

The formation of ammonium from ammonia plus H⁺ an acid moiety rather than being counter-productive, has an ergogenic effect as it plays an important role in the regulation of the acid-base balance in the body. The activation of renal production of ammonium from glutamine breakdown and subsequent excretion of ammonium decreases the adverse effects of increasing acidity as exercise progresses, thus further decreasing fatigue and improving exercise performance.

The degree to which ammonia forms the ammonium ion depends on the pH of the solution. If the pH is low, the equilibrium shifts to the right: more ammonia molecules are converted into ammonium ions. If the pH is high (the concentration of hydrogen ions is low), the equilibrium shifts to the left: the hydroxide ion abstracts a proton from the ammonium ion, generating ammonia, which in turn can be used for the synthesis of amino acids, nucleotides, ATP, etc. or can be converted to urea for excretion, or the ammonium can be directly excreted.

The use of glutamine supplements besides increasing the production of ammonium through the deamination processes leading to glutamate and then alpha-ketoglutarate also has beneficial effects on systemic acid accumulation secondary to prolonged strenuous exercise. After formation of ammonium from glutamine, the alpha-ketoglutarate may be degraded to produce two molecules of bicarbonate, which are then available as buffers for dietary acids, thus adding to the net acid disposition that occurs with ammonium excretion and resulting in a decrease in fatigue and improved exercise/sport performance.

It's also been shown that ammonium regulates mTORC1 and mTORC2 signaling. A recent study concluded that "ammonium triggers the AKT-dependent phosphoinhibition of the TSC complex and of PRAS40, two negative regulators of mTORC1. Consistent with mTORC1 stimulation, ammonium induces the inhibitory phosphorylation of 4EBP1, a negative regulator of protein biogenesis. mTORC1 responds to nutrients, energy levels and growth factors and stimulates translation and anabolic metabolism while inhibiting autophagy. ammonium derived from upregulated glutaminolysis, could turn advantageous for proliferation by triggering key signaling pathways promoting growth."²³

Glutamine and Stress, Injury and Aging

Aging is inevitable, at least for now. And with it comes deterioration of our bodies, increasing disease, and common to it all increased inflammation. The many genetic and epigenetic factors involved that dictate the effect of age on our bodies and minds is beyond the scope of this information piece.

However, one aspect of inflammation and aging involves the heat shock proteins (HSP), especially HSP70, which have anti-inflammatory properties and decrease with aging. HSP also are decreased in couch potatoes and the obese.

It's also been known for several decades that glutamine is involved in modulating levels of heat shock proteins (HSP).²⁴ More recently it's been shown that glutamine's effects on increasing HSP are vital to cell defense and repair under many circumstances including various stressors such as intense exercise, toxins, diseases, and aging.

Oral supplementation with L-glutamine, in free or dipeptide form, can restore the glutamine-glutathione axis, and provide cytoprotection mediated by HSP-27, thus attenuating biomarkers of cell

disruption and damage, as shown in rats submitted to high-intensity resistance and endurance exercise training.²⁵²⁶

A recent review concluded the following, mostly in respect to aging but the information has much wider implications:²⁷

Glutamine is essential for the maintenance of normal neuronal physiology and skeletal muscle size and function due to its capability of controlling the HS response. Changes in physiological systems (e.g., cardiovascular, endocrine, muscular, nervous) that occurs with aging, along with simultaneous unfavorable changes in body composition (i.e., sarcopenia and visceral/abdominal obesity) may lead to, respectively, lower availability of glutamine and chronic low-grade inflammation. Under these conditions, bodily levels of glutamine may reduce, thus affecting its physiological roles. As glutamine is essential for normal HSF1/HSP70 axis activation, the stress response is likely to be reduced in many elderly people. Exercise is a powerful and low-cost physiological inducer of the HS response, being capable of reverting age-associated low-HS response states. **Therefore, exercise training associated with glutamine supplementation and heat treatment itself are envisaged as important therapeutic tools able to restore the stress response in the elderly, allowing normal HSP70 synthesis and the maintenance of muscle integrity, size, regeneration, and rapid recovery from injury. In addition, the re-establishment of the HS response by glutamine supplements, under specific and controlled conditions, may also reduce the incidence of neurodegenerative diseases thus increasing longevity with health.**

Glutamine and Heat Stress/Exhaustion/Stroke

With climate change, there has been and will continue to be more intense waves of drought and heat, usually together, throughout the world. We've seen several examples of extreme climate events over the last few decades, especially prominent were the heatwaves involving large masses of land in Russia in 2010 and in Western and Central Europe in 2003.²⁸ Heat stress, while common under conditions of heat and exercise, will become more prevalent in the coming years.

But regardless of whether you believe in climate change, heat stress is common under conditions of exertion in a hot environment. In most people heat stress results from unaccustomed or over exertion in the heat which leads to dehydration and metabolic changes in the body including deficits in the cardiovascular system and energy metabolism. The result of heat stress includes various symptoms and an inability to continue exercising at any significant level of exertion.

Heat stroke can occur by continuing to push past the symptoms to the point where symptoms become so severe resulting in severe symptoms that often require medical intervention. Taken to the extreme, heat stroke can and has resulted in deaths even among elite athletes.

The problem with athletes is that they can be over motivated and along with the misguided motto of no pain, no gain, can ignore the warning signs until they get into real trouble.

As such, it's important to listen to your body and to pick up on signals that you're undergoing heat stress, such as thirst that isn't quenched, being overly hot and not able to cool down, fatigue, nausea, feelings of faintness, and muscle cramps before it becomes a medical problem.

But you can help avoid heat stress by keeping fluid intake above sweating loss, take salt and other electrolytes, rest when feeling even the slightest symptoms, and don't continue to exercise until you are free of symptoms.

But there's more to the story of heat stress and the more severe exertional heat stroke. Heat stress is associated with activation of systemic and local inflammatory pathways, involvement of heat shock proteins, and adverse changes in the gastrointestinal tract including increased intestinal permeability.

And since we're covering glutamine, it so happens that supplemental glutamine, along with hydration, cooling and rest, can help to both prevent and overcome heat stress. Heat shock proteins are complex proteins that increase under stress, and particularly under heat stress and are protective to tissues, helping the body cope with systemic inflammation and the increase in gut permeability that are important hallmarks of heat stress.

Several studies have shown that supplemental glutamine positively modulates the heat shock proteins, decreases intestinal permeability, protects body proteins from becoming dysfunctional, and decreases systemic inflammation.²⁹³⁰

Enhancing the Beneficial Effects of Glutamine

But there's more to the story since Amino contains several other ingredients that have additive and synergistic effects on body composition and performance but also facilitate the benefits of glutamine supplementation.

Glutamine plus Alanine

As an example, L-alanine, which is also in Amino, is a non-essential amino acid that has benefits on its own but also works to improve the beneficial effects of other ingredients that are also in Amino.

Studies have shown that the combination of glutamine and alanine is an effective non-invasive alternative to increase body L-glutamine pools. And that chronic oral supplementation with L-glutamine, whether in its dipeptide form or in the free form, to a limited extent by itself but better if taken along with L-alanine, represents an effective nutritional method to maintain L-glutamine stores, which attenuate the release of substances indicative of muscle damage and oxidative stress by enhanced glutathione antioxidant system and HSP70 response, thus improving the beneficial effects of high-intensity endurance and resistance exercise training.³¹³²³³³⁴³⁵³⁶³⁷

The basis as to why glutamine plus alanine is more effective to bring out the benefits of glutamine supplementation on body composition and performance enhancement has not been fully worked out. However, alanine and glutamine metabolic routes often work in parallel, particularly in active muscle as both are transported from muscle to other tissues for various reasons.

The formation of both for transport to other parts of the body, especially the liver, and immune and gastrointestinal systems involves the catabolism of other skeletal muscle amino acids, specifically, leucine, isoleucine, valine, aspartate, glutamate, asparagine, arginine, and proline. Supplementation with both alanine and glutamine spares these amino acids so they can be used to maintain or increase skeletal muscle mass.

During exercise, as systemic glucose levels decrease, both glutamine, mostly in the kidney, and alanine, mostly in the liver, are used for glucose formation by gluconeogenesis. Alanine supplementation decreases the breakdown of muscle tissue to procure both alanine and glutamine so they can be used to replenish systemic glucose. It also decreases the use of muscle pyruvate for the formation of alanine, which is then exported out of skeletal muscle to be used mainly by the liver to make glucose via gluconeogenesis.

The more strenuous the exercise, the more alanine is produced and less pyruvate is available in skeletal muscle which compromises protein synthesis and skeletal muscle performance. To some extent the degree in which pyruvate is cannibalized to form alanine for glucose formation outside of skeletal muscle can be seen by elevations of the enzyme alanine transaminase (ALT), often elevated with exercise and just as often mistaken as a sign of liver disease when in fact it's more a sign of alanine formation due to depletion of glucose secondary to exercise. Alanine supplementation with exercise will decrease ALT levels since the transamination reaction to form alanine isn't as active.

As well, alanine plus glutamine together have an increased effect on heat shock proteins and thus on the benefits of maintaining the heat shock response to stress and aging.³⁸

Besides its effects when used with glutamine, a recent study found that an amino acid mixture enriched with arginine, alanine, and phenylalanine (all in Amino) stimulates fat metabolism and as such is useful for improving body composition and weight loss.³⁹

For more info on alanine see the information above under glutamine and the article [Alanine – the Essential, Non-Essential Amino Acid](#).

Taurine

Taurine ((2-aminoethane-sulfonic acid), a sulfur-containing amino acid is the second most abundant amino acid in the body, the most abundant free amino acid found in skeletal muscle tissue, the heart and brain. It's also one of the most abundant amino acids in most organs in the body. Although it's one of the few amino acids not directly used for protein synthesis, it can indirectly increase protein synthesis. Taurine has many properties including its abilities to protect joints, and protect the liver, as well as its antioxidant, anti-inflammatory, immune, osmoregulation, and anabolic effects.

Taurine is a nutrient that enhances the training effect by its many roles in improving musculoskeletal function and protection including increasing growth hormone and IGF-1, and decreasing inflammation, muscle soreness, and injury.⁴⁰⁴¹⁴²⁴³⁴⁴⁴⁵⁴⁶⁴⁷⁴⁸⁴⁹⁵⁰⁵¹⁵² A recent study concluded that **“taurine administration exhibited protective effects by inhibiting MMP-3 and CHOP expression, and subsequently alleviated the OA symptoms in experimental rat models.”**⁵³

Taurine is considered a potent antioxidant and cytoprotective agent that may be useful for combating the adverse effects of physical and psychological stress, and aging.^{54,55,56,57} Taurine has also been shown to have insulin like effects and to help control cell volume. The volumizing effect on muscle cells is felt to lead to an increase in protein synthesis.

Over the years, oral taurine administration has been shown to help muscle cramping in patients with liver cirrhosis and myotonic dystrophy. Several studies have suggested that it may also help to alleviate muscle cramps occurring during and after exercise.

A study on rats has shown that oral taurine supplementation may increase muscle performance and reduce muscle injury caused by exercise.⁵⁸ The aim of the study was to determine if increasing muscle levels of taurine would decrease free radical damage after exercise-induced injury. The authors found that first taurine levels rose in muscle after supplementation, and secondly that running performance was improved by the taurine supplementation.

Another study also in rats showed that taurine is useful for reducing physical fatigue and muscle damage during exercise training, presumably due to its antioxidant effects and the beneficial effects that taurine has on metabolism and on muscle and cardiac functions.⁵⁹

A recent study found that taurine supplementation in patients with heart failure increases their exercise capacity.⁶⁰ Another recent study found that taurine decreases oxidative stress in skeletal muscle after eccentric exercise.⁶¹

And as if that weren't enough, there is some evidence to show that taurine may enhance training further by decreasing training induced fatigue. A paper has shown that Na⁺-K⁺-ATPase activity is depressed with fatigue, regardless of training state, suggesting that this may be an important determinant of fatigue.⁶² Another paper associated fatigue and training with reduced Ca²⁺-ATPase activity.⁶³ Previous studies have shown that taurine stimulates Na⁺-K⁺-ATPase activity and the pumping rate of the Ca²⁺-activated ATPase pump.

While the evidence from these studies is circumstantial another study found that supplemental taurine, besides all the positive effects we know it has, also reduces exercise induced fatigue.⁶⁴

Taurine has been found to have beneficial anti-aging effects on muscle function and performance likely because of its antioxidant and anti-inflammatory effects, and its role in regulating signaling pathways involved in the maintenance of muscle homeostasis.⁶⁵ It's also considered to have beneficial effects on muscle disorders and various other pathological states.⁶⁶

Because of all these properties, taurine (1000 mg per serving) is an integral part of Amino.

For more information on taurine have a look at my recently updated article at https://metabolicdiet.com/wp-content/uploads/2017/product_pdf/Taurine.pdf.

Other Examples

Glutamine, along with other osmolytes in Amino, including the amino acids arginine, lysine, taurine, and proline, protect cells from stress and increase protein synthesis secondary to the volumizing effects on muscle cells.

However, excessive amounts of glutamine are not necessary to obtain all the effects of glutamine supplementation since the inclusion of glutamate and alpha-ketoglutarate in Amino also contribute to the beneficial effects of Amino on health, body composition and performance.

Overall Effect of Glutamine

Glutamine's beneficial effects on body composition, performance, and recovery is a consequence of multifactorial cell and systemic mechanisms, including: ⁶⁷⁶⁸⁶⁹⁷⁰⁷¹

- inhibition of inflammatory pathways,
- accumulation of intracellular osmolytes thus affecting hydration,
- synthesis of antioxidants especially the potent endogenous antioxidant glutathione,
- the synthesis of energy metabolism intermediates especially alpha-ketoglutarate,
- control of global ammonia levels throughout exercise,
- decreasing acidity secondary to exercise,
- increased protein synthesis through activations of mTORC1,
- decreasing excessive muscle damage and the suppression of neutrophil function,

- working additively and synergistically and affecting the metabolism of other amino acids such as the BCAAs and alanine,
- and activation of heat shock response intermediates especially HSF-1 and HSP70.

Simply put glutamine supplementation decreases fatigue and improves the body composition and performance enhancing effects of exercise.

Vitamin B6 and **Vitamin C** have been added since both are crucial for optimizing protein synthesis and recovery of the neuromuscular system secondary to exercise stress.

Both Beta-alanine and Carnosine (a dipeptide beta-alanyl-L-histidine) were added to Amino because of their powerful antioxidant, anti-inflammatory, and immune system effects, as well as its beneficial effects on performance, healing and recovery.^{72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93}

Carnosine, a potent antioxidant and buffering agent, is found in the highest concentration in muscle and brain, where it is felt to have an anti-ischemic effect and thus protect and buffer these tissues.

Carnosine has beneficial effects on exercise performance by helping to overcome muscle fatigue, likely due its effectiveness as a buffering agent, and perhaps its antioxidant, chelating, and enzyme regulating effects.⁹⁴

Carnosine is also believed to decrease both central and peripheral fatigue. In the brain, it is also used to synthesize neurotransmitters which are involved in fatigue. In muscle, carnosine decreases exercise fatigue and contribute to recovery.

Carnosine also inhibits glycation, a destructive protein/sugar reaction that occurs in the body and which contributes to metabolic dysfunction and aging through several mechanisms including the breakdown of connective tissue, a loss of elasticity, and a decrease in cellular hydration.⁹⁵ Carnosine, along with alpha lipoic acid (both in Amino) provide protection against glycation, tissue stress, and premature aging.⁹⁶

As is known, exercise is a catabolic process. Ordinarily this catabolic process continues even though exercise is stopped. Carnosine has an immediate effect on helping to change the catabolic state to one that's anabolic and aiding recovery in this and other ways. It also has beneficial effects on muscle damage and on increasing blood flow in muscle.⁹⁷

Carnosine levels tend to be higher in athletes such as sprinters^{98,99} and in bodybuilders¹⁰⁰ For example, one study found that high levels of muscle carnosine increased performance in the latter half of short maximal cycle sprinting.¹⁰¹ Another study found that beta-alanine supplementation increased muscle carnosine levels¹⁰² and resulted in an improvement in exercise performance.¹⁰³

These studies also show that intramuscular carnosine may be an effective physiological H⁺ buffer and that there is a significant relationship between the carnosine concentration in human skeletal muscle and high intensity exercise performance. Studies have shown that beta-alanine supplementation increased muscle carnosine levels¹⁰⁴ and results in an improvement in exercise performance.¹⁰⁵

Since dietary carnosine is absorbed across intestinal epithelial cells, using carnosine itself would seem to be more useful than using beta-alanine. However, a recent study found that using carnosine and beta-alanine together results in a greater effect than using either one alone.¹⁰⁶ As such, I've included both in Amino V.

In line with the beneficial effects of combining beta-alanine and carnosine, the amino acid **L-histidine** also plays an important role in combination with both, aside from its effects on increasing protein synthesis. That's because although beta-alanine is considered the rate-limiting precursor for carnosine synthesis, L-histidine levels may be lowered as it's used in the formation of carnosine and thus lower levels of histidine may compromise protein synthesis.¹⁰⁷ Because histidine can be a conditionally essential amino acid under certain conditions **Amino contains 650 mg of L-histidine in every dose.**

The inclusion of **Taurine** in Amino, besides its other beneficial roles, is also useful in combination with **carnosine (both in Amino)** since the combo has been shown to have protective properties towards testicular tissue and consequently for testosterone production.¹⁰⁸

Citrulline Malate (CM), a mixture of citrulline and malate, was added for several reasons. Citrulline has several effects, including increasing ammonia clearance, increasing bicarbonate, ornithine, arginine, and citrulline levels. Malate, a tricarboxylic acid cycle (TCA) intermediate, has beneficial effects on energy metabolism mainly by facilitating aerobic ATP production through anaplerotic reactions.

Overall, studies suggest that citrulline malate supplementation can boost athletic performance and enhance recovery by eliminating the amino acid breakdown products of protein metabolism and augmenting the detoxifying capacity of liver cells in removal of ammonium and lactate from the blood.¹⁰⁹¹¹⁰¹¹¹¹¹²¹¹³¹¹⁴¹¹⁵¹¹⁶ These actions decrease fatigue, enhance recovery and facilitate the shift from the catabolic training state to the post exercise anabolic state.

Adding to the effect on energy metabolism is the presence of **arginine, glycine** and **methionine** in Amino. That's because creatine can be produced endogenously via a two-step process involving these three amino acids.

As well, the combination of arginine and glycine, along with the ketoisocaproic acid (KIC) that is formed from leucine, make up a trio that has been found to be a useful combination if used after exercise, and before doing any further exercise.¹¹⁷

Selenium is an essential trace element that provides antioxidant protection in concert with vitamin E (both in Amino). Several selenoproteins have been identified, but only one, glutathione peroxidase (SeGSHpx), a selenoenzyme, has a known function, that of neutralizing toxic lipid hydroperoxides¹¹⁸. Selenium, however has several metabolic effects not associated with glutathione peroxidase¹¹⁹.

Many of the nutrients have multiple actions in the body. For example selenium also has significant anti-inflammatory properties and involved in thyroid health and function..¹²⁰¹²¹

Besides the beneficial effects of the above and other added ingredients, Amino IV has a host of other ingredients that together make Amino IV the premier amino acid supplement.

Summary

Amino, used before and immediately after training is an easy to take, easy on the stomach, source of amino acids and other ingredients that kicks protein synthesis into high gear. As such, you can begin taking advantage of its effects on countering protein catabolism while exercising, and that post-training window of opportunity. Amino is formulated to provide a square wave increase in the availability of blood amino acids and synergistic compounds within minutes after ingestion, and a measurable decrease in protein catabolism and increase in muscle protein synthesis within less than half an hour – much faster than other pre and post exercise supplements.

The amino acid, peptide blend, and special ingredients in Amino work together synergistically to immediately increase blood amino acid levels, insulin sensitivity and insulin levels, as well as growth hormone, IGF-I and testosterone levels, resulting in increased muscle protein synthesis which maximizes the anabolic and fat burning effects of exercise and combats overtraining.

Amino can also be used throughout the day to give a rapid pulsed increase in amino acids and anabolic hormones that leads to short burst increases in muscle protein synthesis. Research has shown that pulses of high levels of amino acids are much more effective in increasing protein synthesis than sustained high levels.

The bottom line is that the new Amino version V will stimulate GH and IGF-1 levels and increase insulin sensitivity. These hormonal changes, along with a rapid increase in amino acids results in a dramatic increase in protein synthesis and fat loss, decrease muscle degradation, improve recovery, increase energy, and result in an anabolic kick whenever it's used, especially before and right after training.

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A Three-Phase Workout System For The Power and Endurance Athlete



Exersol is the most advanced, three-phase exercise-orientated nutritional support system ever formulated. Exersol gives you the peace of mind that comes with knowing you have everything you could possibly ever need to maximize the anabolic and fat burning effects of exercise. Exersol allows you to train harder and more effectively, making the training you do before, during and after, that much more productive.

Those who want to maximize the anabolic and fat burning effects of exercise should also look at [Exersol](#), the EXERCISE SOLUTION, which includes [Resolve](#), [Power Drink](#), and [Amino](#).

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