

# Anabolic Synergism - Amino Acids and Exercise

Higher tissue levels of amino acids translate into increased protein synthesis as shown by a number of studies using both oral amino acids and amino acid infusions.<sup>1,2,3,4,5</sup>

For example, one study by using femoral arterio-venous catheterization and quadriceps muscle biopsies, measured muscle protein synthesis and breakdown, and amino acid transport during intravenous infusion of an amino acid mixture in young and elderly subjects.<sup>6</sup> Peripheral amino acid infusion significantly increased amino acid delivery to the leg, amino acid transport and muscle protein synthesis, independently of the age of the volunteers. Despite no change in protein breakdown during amino acid infusion, a positive net balance of amino acids across the muscle was achieved.

The same team of researchers published another study several years later and determined that a bolus oral ingestion of amino acids also produce a similar response in young and elderly individuals.<sup>7</sup>

This was in agreement with an earlier study that came to the same conclusion on the similar effectiveness of oral versus intravenous infusion of amino acids.<sup>8</sup> However, this earlier study also found that whole body proteolysis did not change with the oral amino acids whereas it increased slightly during parenteral amino acid administration. This is interesting in that it suggests that oral amino acids may actually be more effective in modulating protein metabolism than intravenous ones. It's possible that the oral amino acids results in the appearance of lower levels of systemic amino acids for a longer period of time and that this difference may account for the fact that there was no change in whole body proteolysis with the oral amino acids.

Having established that oral amino acids effectively deliver amino acids to muscle and increase protein synthesis it's worth while to see what effects an oral amino acid mix would have if taken before and/or after training.

## Amino Acid Blend Before Training

In the last several years a number of studies have found that ingesting amino acids prior to training provides several beneficial effects. First of all a recent study found that amino acid delivery during exercise is greater when an essential amino acid mix is ingested than when intact whey proteins are ingested immediately before exercise.<sup>9</sup>

An earlier study found that taking an essential amino acid mix prior to exercise gives superior results to its use after exercise.<sup>10</sup>

Another recent study found that a single oral intake of 2 grams of BCAAs with arginine at onset of exercise suppressed exercise induced muscle proteolysis.<sup>11</sup>

And another study found that the use of whole proteins prior to exercise decreased serum growth hormone, IGF-I, testosterone, and free fatty acid levels, and increased insulin levels.<sup>12</sup> All of these changes are counterproductive for maximizing body composition. The only productive response was an increase in amino acid levels.

Using an amino acid mix containing specific amounts and ratios of various amino acids can result in an optimum pre training mix that maximizes the anabolic and fat burning effects of exercise.

## **MD+** Amino version III

[Amino](#), my amino acid supplement, used before training results in an increase in anabolic hormones, a decrease in muscle catabolism and damage (thereby decreases counter productive muscle damage, decreasing muscle soreness, and improving recovery), a net protein metabolism, and an increase in fat breakdown and oxidation.

As such, Amino has proven to be useful for both power and endurance athletes for increasing the anabolic and decreasing the damaging effects of exercise, and allowing higher levels of training intensity.

### **Amino After Training**

Amino used immediately after training increases recovery and promotes net protein metabolism, muscle accretion, and continued lipolysis and fat oxidation.

As such, Amino has proven useful in reversing the negative effects of exercise on protein metabolism, enhancing recover, and potentiating the beneficial effects of exercise on body composition and performance.

### **Amino Acid Breakdown of Amino**

Amino contains essential (including leucine and the other branched chain amino acids), conditionally essential (including glutamine and arginine), and non essential amino acids (including glycine and alanine) as studies have shown that all three classifications of amino acids are important for maximizing protein synthesis and muscle accretion.

The mechanism of actions include both direct and indirect effects such as increasing protein synthesis and decreasing protein catabolism by various pathways including increasing insulin secretion and the anabolic effects of insulin (including the anabolic response seen with an increase in insulin plus hyperaminoaccedemia), increasing GH and IGF-I levels, decreasing the effects of myostatin, and influencing various other growth factors, prostaglandins and cytokines.

Studies have also shown that the amino acids in amino work both independently, as a whole, and along with insulin to increase protein synthesis and decrease protein catabolism. These effects appear to be additive. As such, Amino incorporates all the combinations necessary to maximize net protein metabolism, and muscle accretion.

### **One dose – 10 tablets contains:**

Besides the amino acid content Amino also contains several Ingredients that enhance the effects of the amino acids in Amino.

#### **Amino Acid Content**

A total of 15.5 grams of amino acids in the form of free amino acids, amino acid derivatives and metabolites, and peptides

#### **8 grams of Essential Amino Acids (EAA)**

**3.4 grams, or over 40%, of the EAA are in the form of branched chain amino acids (BCAA) – half of the BCAA is in the form of leucine.**

**2.0 grams of the conditional amino acid glutamine**

**0.4 grams of the conditional amino acid arginine**

**0.5 grams of taurine**

**300 mg of alanine**

**4 grams in total of non-essential amino acids, Krebs Cycle intermediates, and related compounds.**

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 acids<sup>13</sup> which may ultimately compromise protein synthesis in situations where there is rapid growth.

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, 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.<sup>14,15,16</sup>

Amino Also contains a number of ingredients that help to maximize the anabolic and fat burning effects of the amino acids, including vitamin B6 and Vitamin C, which are crucial for optimizing protein synthesis and recovery of the neuromuscular system secondary to exercise stress.

# MD+ Amino

- Maximizes protein synthesis and decreases muscle breakdown before and after training and anytime it's used.
- Maximizes the anabolic and fat burning effects of exercise.
- Enhances recovery.

<b>Supplement Facts:</b> Serving Size: 10 Tablets Servings Per Container: 15					
	Amount Per Serving	% Daily Value		Amount Per Serving	% Daily Value
Vitamin C	100 mg	167%	Alanine	250 mg	*
Vitamin B6	10 mg	500%	Glycine	250 mg	*
Vitamin B12 (Cyanocobalamin)	50 mcg	833%	Serine	250 mg	*
Biotin	50 mcg	16.5%	Calcium Alpha Ketoglutarate	300 mg	*
Chromium	25 mcg	21%	L-arginine Aspartate	250 mg	*
Selenium (Selenomethionine)	25 mcg	36%	Alpha Lipoic Acid	100 mg	*
Histidine	650 mg	*	<b>Amino™ Proprietary Complex (APC) 7,900mg</b>		
Isoleucine	700 mg	*	Glutamine Peptides (Glutamine, Proline, Branched Chain		
Leucine	1.2 g	*	Amino Acids, Phenylalanine, Serine, Glutamate, Glycine,		
Lysine	900 mg	*	Arginine, Tyrosine, Threonine, Cysteine, Asparagine/Aspartate,		
Methionine	250 mg	*	Alanine, Histidine, Methionine, Ornithine),		
Phenylalanine	900 mg	*	Carnosine, Citrulline Malate, Dicalcium Phosphate,		
Threonine	900 mg	*	Potassium Succinate, Magnesium Fumarate,		
Valine	700 mg	*	AMP (Adenosine Monophosphate)		
Taurine	500 mg	*			
*Daily Value not established					
Other Ingredients: Stearic Acid, Modified Cellulose Gum, Magnesium Stearate, Silicon Dioxide, Hydroxypropylmethyl Cellulose.					

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](#).

## References:

- <sup>1</sup> Tipton KD, Ferrando AA, Phillips SM, Doyle D Jr, Wolfe RR. Postexercise net protein synthesis in human muscle from orally administered amino acids. *Am J Physiol*. 1999;276(4 Pt 1):E628-34.
- <sup>2</sup> Volpi E, Kobayashi H, Sheffield-Moore M, Mittendorfer B, Wolfe RR. Essential amino acids are primarily responsible for the amino acid stimulation of muscle protein anabolism in healthy elderly adults. *Am J Clin Nutr*. 2003;78(2):250-8.
- <sup>3</sup> Tipton KD, Borsheim E, Wolf SE, Sanford AP, Wolfe RR. Acute response of net muscle protein balance reflects 24-h balance after exercise and amino acid ingestion. *Am J Physiol Endocrinol Metab*. 2003;284(1):E76-89.
- <sup>4</sup> Paddon-Jones D, Sheffield-Moore M, Aarsland A, Wolfe RR, Ferrando AA. Exogenous amino acids stimulate human muscle anabolism without interfering with the response to mixed meal ingestion. *Am J Physiol Endocrinol Metab*. 2005;288(4):E761-7.
- <sup>5</sup> Killewich LA, Tuvdendorj D, Bahadorani J, Hunter GC, Wolfe RR. Amino acids stimulate leg muscle protein synthesis in peripheral arterial disease. *J Vasc Surg*. 2007;45(3):554-9;discussion 559-60.
- <sup>6</sup> Volpi E, Ferrando AA, Yeckel CW, Tipton KD, Wolfe RR. Exogenous amino acids stimulate net muscle protein synthesis in the elderly. *J Clin Invest*. 1998;101(9):2000-7.
- <sup>7</sup> Paddon-Jones D, Sheffield-Moore M, Zhang XJ, Volpi E, Wolf SE, Aarsland A, Ferrando AA, Wolfe RR. Amino acid ingestion improves muscle protein synthesis in the young and elderly. *Am J Physiol Endocrinol Metab*. 2004;286(3):E321-8.
- <sup>8</sup> Rasmussen BB, Wolfe RR, Volpi E. Oral and intravenously administered amino acids produce similar effects on muscle protein synthesis in the elderly. *J Nutr Health Aging*. 2002;6(6):358-62.
- <sup>9</sup> Tipton KD, Elliott TA, Cree MG, Aarsland AA, Sanford AP, Wolfe RR. Stimulation of net muscle protein synthesis by whey protein ingestion before and after exercise. *Am J Physiol Endocrinol Metab*. 2007 Jan;292(1):E71-6.
- <sup>10</sup> Tipton KD, Rasmussen BB, Miller SL, Wolf SE, Owens-Stovall SK, Petrini BE, Wolfe RR. Timing of amino acid-carbohydrate ingestion alters anabolic response of muscle to resistance exercise. *Am J Physiol Endocrinol Metab* 2001;281:E197-E206,
- <sup>11</sup> Matsumoto K, Mizuno M, Mizuno T, Dilling-Hansen B, Lahoz A, Bertelsen V, Munster H, Jordening H, Hamada K, Doi T. Branched-chain Amino Acids and Arginine Supplementation Attenuates Skeletal Muscle Proteolysis Induced by Moderate Exercise in Young Individuals. *Int J Sports Med*. 2007 Jun;28(6):531-8.
- <sup>12</sup> Hulmi JJ, Volek JS, Selanne H, Mero AA. Protein ingestion prior to strength exercise affects blood hormones and metabolism. *Med Sci Sports Exerc*. 2005 Nov;37(11):1990-7.
- <sup>13</sup> Iapichino G, Ronzoni G, Bonetti G, Corti M, Grugni L, Guarnerio C, Palandi A, Pasetti G, Rotelli S, Savioli M. [Determination of the best amino acid input after orthotopic liver transplantation]. *Minerva Anestesiologica* 1992;58(9):503-8.
- <sup>14</sup> Harris RA, Joshi M, Jeoung NH. Mechanisms responsible for regulation of branched-chain amino acid catabolism. *Biochem Biophys Res Commun* 2004;313:391– 6.
- <sup>15</sup> Shimomura Y, Murakami T, Nakai N, Nagasaki M, Harris RA. Exercise promotes BCAA catabolism: effects of BCAA supplementation on skeletal muscle during exercise. *J Nutr* 2004;134:1583–7.
- <sup>16</sup> Paxton R, Harris RA. Regulation of branched-chain -ketoacid dehydrogenase kinase. *Arch Biochem Biophys* 1984;231:48 –57.