

Alanine – the Essential, Non-Essential Amino Acid

The emphasis these days has shifted to specific amino acids over the use of others. For example the essential amino acids, and especially leucine are considered important and many feel that the other amino acids aren't necessary. Others feel that a few of the conditionally essential amino acids, such as glutamine and arginine are also extremely important for maximizing body composition and exercise performance.

But that's not the case. All of the amino acids are important in one way or another and ignoring can be a big mistake.

Let's take alanine for example. Most feel that alanine, a non-essential amino acid, has no place in an amino acid formulation. But they're wrong.

During exercise skeletal muscle releases alanine into the circulation in direct proportion to the intensity of the exercise.¹ However, although yielding much needed energy, this catabolism of BCAAs and cellular protein (to produce glutamine and alanine) is counterproductive. Any loss of amino acids is detrimental if they could have been used to maintain or increase skeletal muscle mass.

A recent study suggested that alanine intake before and during prolonged exercise conserved carbohydrates and enhanced protein metabolism.² In this study, six healthy male athletes took in 74g of alanine during prolonged exercise (lasting 180 minutes) at an intensity of 53% of VO₂max. During the three hours of exercise, 51g (69%) of the alanine was actually oxidized to provide 10% of the total energy needed for the training session. In this study very little of the nitrogen from the supplemented alanine was lost in either urine or sweat, a situation which led to a positive nitrogen balance during the workout.

What's interesting about this study is that protein synthesis can be increased when a large amount of a single amino acid is ingested, even if that amino acid is considered a dispensable or non-essential amino acid. This is counter to many studies showing that only the inclusion of the essential amino acids or leucine, results in an increase in protein synthesis or even a decrease in protein catabolism.

Another interesting result is that alanine, which is usually exported to the liver from muscle, was actually taken up by muscle and used as fuel directly in the muscle without going to the liver first to be converted to glucose which then in turn is shunted to skeletal muscle. As well, the alanine decreased ketogenesis,^{3,4} likely because the alanine by serving as a direct (oxidized directly in muscle – alanine is deaminated, and decarboxylated to form pyruvate and through the action of pyruvate dehydrogenase enters the Krebs Cycle as acetyl-CoA) and indirect (acting as a substrate for gluconeogenesis – pyruvate is carboxylated by pyruvate carboxylase to oxaloacetate) fuel source decreased the need for the use of ketones as fuel.

The concentration uptake of some amino acids (i.e. those transported by sodium (Na⁺)-dependent mechanisms into muscle and liver cells) can increase cellular hydration, thereby triggering a protein-anabolic signal. Such a case has been postulated for both

glutamine and alanine.⁵ In one study it was concluded that "it seems plausible to conclude that stimulation of K⁺ inflow plays a major role in the mechanism of alanine-induced stimulation of protein synthesis through changes in cell volume."⁶

Alanine is found in appreciable levels in many foods including beef, lamb, milk products, corn meal, peas and potatoes. However there is no appreciable alanine in many foods including chicken, fish, eggs and bacon. Now while bacon is not a common food consumed by bodybuilders, chicken, fish and eggs are the staple of many bodybuilding diets.

Many bodybuilders are on a restrictive diet that may include little else besides large quantities of these three foods for months at a time and some bodybuilders stay on this kind of restricted diet almost year round. Even non-competing bodybuilders may run into problems with obtaining enough dietary alanine. Today low fat diets are recommended in order to decrease saturated fat intake. This usually means decreased consumption of beef, lamb, and milk products. Again overall alanine intake may be low.

Thus some diets, especially calorie restricted diets, may be moderately or even severely alanine deficient making high quality protein and/or alanine supplementation a necessity. Since alanine is a non essential amino acid, can't the body make it as it needs it? Yes it can but alanine synthesis by the body is part of the problem.

One way to increase the availability of a specific amino acid, whether essential or non-essential is to cannibalize cellular structural and contractile proteins and use the needed amino acid as it's released. In the case of nonessential amino acids, they can also be formed from other released amino acids. As noted above both processes contribute to alanine production.

In general if there is a deficiency of or need for any one amino acid (AA) then the body will catabolize body proteins in an effort to supply the needed AA, regardless of why the AA is needed; whether for protein synthesis of needed proteins and enzymes, or for gluconeogenesis (the conversion of amino acids and other substrates into glucose). Thus, the use of exogenous alanine prior to and after exercise might be expected to decrease exercise induced proteolysis and increase the availability of intracellular AAs for protein synthesis.

It has been shown that the amino acid alanine has effects on both insulin and glucagon and raises plasma glucose concentrations in diabetics⁷, and can produce sustained glucose recovery from hypoglycemia.⁸ As well it has been shown that alanine decreases proteolysis⁹ and is a potent stimulus for protein synthesis. Although the mechanism of this action has not yet been determined, it is felt that this increase in protein synthesis might be secondary to the provision of an energy source¹⁰ or an increase in cellular hydration (see below). The uptake of alanine increases the intracellular content of K⁺ and the cell volume.¹¹

The use of exogenous alanine would decrease the need for catabolism of muscle, and provide a stimulus for protein synthesis both directly and by helping to maintain the intracellular pool of free amino acids by decreasing the use of other amino acids for

alanine production. As well exogenous alanine would provide extra energy for anaerobic muscular contraction both by allowing BCAAs to be oxidized if need be rather than used to produce alanine, and by providing an increase in hepatic and systemic and thus intracellular glucose availability.

A diet low in alanine should be supplemented with alanine rich protein foods or supplements. The supplements that consist of whole protein, hydrolyzed protein or mixtures of amino acids, offer a low calorie source of alanine and other amino acids. These supplements are not merely useful convenient alternative food choices, but necessary for protein synthesis and the maintenance of lean body mass.

Because of its anabolic and anticatabolic effects, a case could be made for alanine supplementation for all athletes wishing to maximize lean body mass and performance, regardless of dietary alanine intake.

MD+ Amino



As such, alanine is included in **MD+ Amino**, my amino acid formulation, both as free alanine and also as alanine bound up in peptides secondary to the use of glutamine peptides in my Amino formulation.

Amino is a cutting-edge amino acid formula consisting of free amino acids together with glutamine and other peptides. The amino acid blend in Amino is engineered to assist in protein synthesis, deal with the effects of excessive exercise and maximize the anabolic and fat-burning effects of exercise.

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