Branched Chain Amino Acid Supplementation

Popular bodybuilding websites that promote products for muscle mass suggest that branched chain amino acids (leucine, valine, and isoleucine) are so key to muscle hypertrophy that they are a requisite dietary supplement to mass gain. Other claims include branched chain amino acids are needed by athletes to fuel exercise, spare glycogen, increase protein synthesis, reduce protein loss during exercise, reduce muscle soreness, reduce fatigue, improve immune function, and consequently improve performance from potentially any of the above. Although a lack of supportive evidence has been demonstrated in controlled trials, fitness enthusiasts, body builders, and athletes still use the dietary supplements in hopes of gaining a training edge.

Amino acids termed essential cannot be made from other amino acids making them an inherent component to the daily diet. Both essential and non-essential acids are involved in a variety of biochemical and physiological processes and are constantly involved in anabolic and catabolic activity, not unlike bone tissue. As proteins are damaged they degrade and are normally replaced to prevent a decline in the tissue's function. Lack of protein and excessive stress can both lead to an imbalance in turnover and cause excess protein loss. Amino acids may also supply energy via conversion to acetyl-CoA or as intermediates in the TCA-cycle in the mitochondria of aerobic cells, while others become synthesized into compounds, like neurotransmitters, hormones and other protein structures.

Muscle contains all of the naturally occurring amino acids with branched chain amino acids comprising up to about 20% of the amino pool. But branched chain amino acids exist in plant structures as well, suggesting that a balanced diet of animal and plant protein can easily meet requirements for training. In fact, 3-4 oz. of chicken breast contains the equivalent of a daily supplemental dose of branched chain amino acids (100 g chicken breast: 470 mg of valine, 650 mg leucine, and 375 mg isoleucine) while a quarter cup of peanuts contains an even a greater concentration of BCAA's.

200 Capsules		
Supplement Facts		
Serving Size 2 Capsules		
Servings Per Container100		
Amount Per Serving		
L-Leucine	500mg	*
L-Isoleucine	250mg	*
L-Valine	250mg	*
*** Daily Value not established.**		

Other Ingredients:

Gelatin, Microcrystalline Cellulose, Magnesium Stearate.

The claim that BCAAs increase muscle mass is based on the known role of amino acids in augmenting the signaling pathway from resistance trained muscle cells and as the building blocks during muscle protein synthesis. Adequate BCAAs, in particular leucine, stimulates the signaling pathways and promote protein synthesis. Early studies indicated that adequate daily protein met the needs of trained muscle when 1.4 – 1.7 grams of protein per kilogram were routinely ingested. The concept of more protein means more muscle has long been the mantra of those emphasizing gains in lean mass, but there is not a direct conversion. In fact, excess protein in the diet is preferentially converted to triglycerides often making what many call the "bulking phase" more of a fattening phase. Cluster analysis of the literature published in the Journal *of Applied Physiology Nutrition and Metabolism (2009)* suggests that inter-individual differences account for the variations in magnitude of adaptations to resistance training and current recommendations in energy intake and protein are sufficient for modest to extreme muscle growth.

This though raises the question as to the role of energy timing in muscle protein synthesis. Clinical and practical outcomes infer that energy and/or protein timing may impact the recovery of muscle tissue and affect protein synthesis post-exercise, leading to better recovery. Due to the fact that myofibrillar protein accretion can occur immediately post-exercise it has been proposed that consuming essential amino acids following training will promote protein synthesis and/or prevent protein breakdown. In a recent 12 week study published in the *European Journal of Applied Physiology (2010)* investigators compared post-exercise consumption of protein to placebo in changes in muscle mass architecture and strength using 29 trained male subjects. Although both groups demonstrated statistically significant improvements, the treatment group demonstrated better results, particularly (and not surprisingly) in those individuals with the lowest starting nitrogen balance and strength.

Although sports scientists are consistent with the general recommendations for protein, give or take 0.25 g/kg of body weight, investigators wanted to identify if greater concentrations of branched chain amino acids would make a substantial difference in the anabolic activity associated with resistance training. In particular, investigators questioned the role added leucine would play in the anabolic response. Recent research published in the *Journal of Nutrition (2010)* tested leucine's stimulatory effects of muscle protein synthesis in human muscle tissue. Using two different leucine concentrations of 1.8 g or 3.5 g ingested in a 10 g serving of essential amino acids following exercise, groups were studied for 180 minutes during post-exercise recovery. Using stable isotopic techniques muscle biopsies were analyzed for leucine kinetics (synthetic rate, signaling etc.). Researchers found higher delivery of leucine in both treatment groups compared to controls. Interestingly, both treatment groups demonstrated no difference in transport or intracellular availability. Likewise, muscle protein synthesis increased similarly in both groups. Researchers concluded that the amino acid and leucine (1.8 g) concentrations typical of 10 g of complete protein, following a bout of strenuous exercise is sufficient to induce maximal skeletal protein anabolic response in young adults. Other studies support these findings with most using whey protein as the post-exercise preference based on its high concentration of essential amino acids and rapid absorption.

When protein was mixed with carbohydrates (20 g protein + 30 g CHO) or (20 g protein + 90 g CHO) and ingested within one hour post-exercise, both groups demonstrated equal response in muscle protein synthesis. Researchers concluded that once an adequate amino pool and energy is reached, additional energy does not further enhance protein synthesis nor improve protein breakdown. This study was supported by research published in 2010 in the *American Journal of Physiology, Endocrinology, and Metabolism* using only 10 g of essential amino acids. The researchers concluded that a complete protein ingested 1-3 hours post-exercise would increase amino acid transport expression, consequently enhancing amino acid intracellular delivery.

Based on these findings it is suggested that protein is a key element in post-exercise recovery and daily intakes for muscle development are consistent with prior research findings. Exercisers should capitalize on the post-exercise internal environment by consuming at least 10 g of complete protein along with adequate carbohydrates (30-60 g) within 30-40 minutes of exercise cessation and whey protein seems to be an ideal choice. Although more research is needed, the current findings do not support supplemental branched chain amino acids when adequate complete protein sources are consumed on a daily basis. The practical take home message is naturally occurring sources like chicken and milk contain adequate concentrations of essential amino acids making BCAA supplements a likely unnecessary expense.

Whey protein Amino Acid Profile Per Serving (1 Scoop):	
Isoleucine (BCAA)	1.8 g
Leucine (BCAA)	3.0 g
Valine (BCAA)	1.3 g
Lysine	2.5 g
Cysteine	1.4 g
Methionine	.70 g
Glutamic Acid	3.0 g
Phenylalanine	1.45 g
Glycine	.60 g
Threonine	1.0 g
Aspartic Acid	2.1 g
L-Tyrosine	1.0 g
Proline	2.4 g
Histidine	.30 g
Serine	1.3 g
Alanine	1.0 g
Trytophan	.60 g

Typical Amino Acid Profile Of Protein	
Per 100g	
Alanine	6.28
Arginine	2.85
Aspartic Acid	11.22
Cystine	2.50
Glutamic Acid	14.55
Glycine	1.54
Histidine	1.85
Isoleucine	5.91
Leucine	11.17
Lysine	9.20
Methionine	2.29
L-Phenylalanine	2.73
Proline	6.34
Serine	6.72
Threonine	4.80
Tryptophan	2.96
Tyrosine	6.14
Valine	0.97