
From the Field – Directed Topic
PROTEIN/AMINO ACID SUPPLEMENTATION AND RESISTANCE TRAINING: A RESEARCH UPDATE.

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ABSTRACT

Strength and power athletes often employ protein and/or amino acid supplementation as part of their training schedule. This brief review provides a research update on the digestive properties of protein and explores the anabolic potential of protein/amino acid supplementation in enhancing the muscular adaptations to resistance training (i.e., increased protein accretion and strength expression). Practical recommendations for protein/amino acid supplementation are provided at the conclusion of this paper.

INTRODUCTION

Supplementation with protein and/or amino acids is reported (6, 9, 19, 26) to enhance protein anabolism and accretion following resistance exercise (Figure 1). Although resistance training ultimately enhances the anabolic process (net gain in muscle mass), catabolic events (protein degradation) dominate if nutrient-signalling interaction is neglected (i.e., consumption of protein-containing meals) (9). However, athletes may find it inconvenient to consume protein-containing meals, such as dairy protein, eggs, and lean meats before or immediately after the exercise bout. Therefore, more portable protein sources, particularly protein/amino acid supplementation, offer a practical alternative (20). This is an important consideration, as the nutrient-signalling interaction of skeletal muscle is suggested (10) to be more sensitive following resistance exercise then at other times of the day, and this is the basis behind the theory of nutrient timing (11, 12).
**RESEARCH UPDATE**

Following protein/amino acid supplementation, the rate of increase in blood levels of amino acid depends not only on the relative contribution of muscle blood flow, but also the amount of muscular contraction. The general concept underlying this approach outlines differences in the digestive properties of proteins (18). For example, casein clots in the stomach, which delays gastric emptying and this results in a sustained ‘slow’ release of amino acids, whereas whey protein is a more soluble ‘fast acting’ protein. Research has shown that amino acids released from casein are present in the bloodstream for a longer period of time and this response lasts longer than for whey protein (5). Conversely, whey protein is absorbed faster and results in a more rapid increase in amino acid availability in the bloodstream (9). The speed of amino acid absorption appears to have a major impact on muscle protein turnover rates following resistance training. The slowly absorbed casein may promote protein accretion by reducing protein breakdown; in contrast, a fast acting protein (whey) stimulates protein synthesis (19).
With the overt differences in the digestive properties of casein and whey protein addressed, there was interest to see if the differences in amino acid availability would have contrasting effects on muscle build up following resistance exercise. One such study (25) placed subjects into one of three groups and received, 20 g casein, 20 g whey, or a placebo beverage 60 min post-exercise. Although the insulin response was twice as high following whey ingestion compared to casein ingestion, both groups demonstrated significant improvements in net muscle balance compared to ingestion of a placebo. This suggests that there is little difference in the muscle responsiveness to casein or whey, and is an interesting finding considering the pattern of amino acid appearance in the blood was markedly different between the two proteins. It is possible that the stimulation of muscle metabolism by resistance exercise may alter the response to casein and whey ingestion. The authors concluded that protein ingestion (casein or whey) stimulates muscle growth to a similar extent by supplying the essential amino acids necessary for post-exercise protein synthesis (25). Therefore, the consumption of combined proteins, whey/casein (13) or whey/leucine (26) may be an effective strategy for promoting maximal gains in muscle mass and strength expression following resistance training.

Research examining the effects of different combinations of branch chain amino acids (BCAA), whey and casein (13), suggests an ergogenic effect that promotes increases in fat-free mass and strength expression beyond that achieved with resistance training and carbohydrate ingestion. Using two different forms of protein supplementation (40 g of whey and 8 g of casein [WC], or 40 g of whey plus 5 g of L-glutamine plus 3 g of BCAA [WBG]), Kerksick et al. (13) examined muscular adaptations (strength and body composition) following 10 weeks of resistance training (upper/lower split; periodised; 3 sets x 6-10 RM; 4 d/wk) in comparison to an isoenergetic amount of carbohydrate (48 g [PLA]) ingested post-exercise. The WC group was the only group that showed significant increases in lean mass (WC = 1.9 kg; PLA: no change; WBG = -0.1 kg, p < 0.05) and fat-free mass (WC = 1.8 kg; PLA = 0.1 kg; WBG = -0.1 kg, p < 0.05), with a trend (p = 0.054) toward a greater increase in body mass (WC = 3.0 kg; PLA: 0.2 kg; WBG = no change). Significant increases in 1RM strength for bench press and leg press were observed across all groups after 10 weeks. Interestingly, while no significant differences in 1RM strength were reported between groups, delta values indicate that the WC group achieved the greatest total strength increase (WC = 21 kg; WBG = 15 kg; PLA = 10 kg). The authors concluded that supplementing the diet with whey/casein mix while resistance training improves muscular adaptations to a greater extent compared to carbohydrates.
Amino acid ingestion also appears to improve exercise performance and recovery from resistance exercise (7), as well as reducing the effects of resistance training overreaching (22). Specifically, essential amino acids (1, 6), and branched-chain amino acids (16, 23) have received attention. Of the amino acids, leucine appears to be the most potent on the anabolic process (8). The amount of amino acids required to enhance the anabolic process appears to be small. Research using 6 g of essential amino acids, both with (4) and without (6) carbohydrates has been shown to enhance protein synthesis and muscle hypertrophy. Collectively, these findings suggest that resistance training combined with amino acid supplementation promote anabolic responses within skeletal muscle.

**SUMMARY**

The findings presented in this research update illustrate the anabolic response of skeletal muscle to protein/amino acid ingestion and provide further evidence that a mixture of proteins has an additive effect on muscular adaptations to resistance training (2). Therefore, nutritional supplementation involving mixed protein intake (whey/casein, EAA or BCAA ingestion) following the principles of nutrient timing (12), should be an integral component of the training plan (3, 21). Strategic protein/amino acid supplementation pre-exercise (24), during the exercise bout (4), and post-exercise (27), appears to be critical in the response skeletal muscle following resistance training (14, 17). Based on this research, table 1 provides recommendations for protein/amino acid supplementation to promote muscular responses to resistance training.

**Table 1 - Recommendations for protein, amino acid supplementation to promote muscular responses to resistance training.**

<table>
<thead>
<tr>
<th>Protein/amino acids</th>
<th>Pre-exercise (15-30 min prior)</th>
<th>During exercise</th>
<th>Immediately post-exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whey</td>
<td>20 g</td>
<td>-</td>
<td>20 g *</td>
</tr>
<tr>
<td>Casein</td>
<td>-</td>
<td>-</td>
<td>20 g *</td>
</tr>
<tr>
<td>EEA</td>
<td>-</td>
<td>6-10 g mix *</td>
<td>-</td>
</tr>
<tr>
<td>PRO</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Abbreviations: EAA = essential amino acids; PRO = protein (whole foods); * denotes combined nutritive mix.

**KEY POINTS**

1. Nutrient timing (pre-exercise, during the exercise bout, and post-exercise) is an essential strategy for promoting muscular
adaptations from resistance exercise;
2. Amino acids that become available during supplementation provide additional raw materials for
3. enhanced muscle growth (protein synthesis) and/or reducing muscle breakdown (protein degradation); and
4. The type of protein/amino acid supplementation significantly affects both muscle growth and exercise performance.

REFERENCES


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