Role of Dietary Protein in Post-Exercise Muscle Reconditioning

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As athletes approach their limits with respect to training volume and intensity, good nutritional practice becomes of even greater importance. It is not surprising that athletes, coaches, and exercise physiologists take great interest in the proposed role of nutrition in the skeletal muscle adaptive response to more prolonged exercise training. A single bout of exercise increases both muscle protein synthesis and, to a lesser extent, muscle protein breakdown rates. However, post-exercise protein balance will remain negative in the absence of food intake. Dietary protein ingestion during or immediately after exercise stimulates muscle protein synthesis, inhibits protein breakdown and, as such, stimulates net muscle protein accretion following resistance as well as endurance type exercise. Protein ingestion during and/or immediately after exercise has been suggested to facilitate the skeletal muscle adaptive response to each exercise session, resulting in more effective muscle tissue reconditioning. Though scientific evidence is scarce, a few basic guidelines can be defined with regard to the preferred type and amount of dietary protein as well as the timing by which dietary protein should be ingested.

It has been reported that post-exercise muscle protein synthesis rates increase with the ingestion of greater amounts of protein, reaching maximal stimulation after ingesting 20 g of a high-quality protein (fig. 1) [1]. Based on these findings, it has been proposed that athletes trying to maximize skeletal muscle protein accretion should ingest this amount of dietary protein 5–6 times daily (table 1). Various studies have reported improvements in post-exercise protein balance and/or greater muscle protein synthesis rates following the ingestion of whey protein, casein protein, soy protein, casein protein hydrolysate, egg protein, and whole milk and/or fat-free milk. Only few studies have tried to assess differences in the post-exercise muscle protein synthetic response between different types of protein. Milk protein and its main isolated constituents whey and casein seem to offer an anabolic advantage over soy protein [2]. Furthermore, whey protein ingestion seems to induce a greater muscle protein...
The differences in the muscle protein synthetic response to the ingestion of various protein sources is likely attributed to their specific digestion and absorption kinetics as well as amino acid composition. Carbohydrate ingestion following exercise is recommended when endogenous glycogen stores need to be replenished within a 24-hour time frame. In addition, many strength athletes often ingest large amounts of carbohydrate with protein during recovery from exercise to further augment post-exercise muscle protein accretion. However, coingesting such large amounts of carbohydrate does not necessarily enhance the muscle protein synthetic response when compared with casein. The differences in the muscle protein synthetic response to the ingestion of various protein sources is likely attributed to their specific digestion and absorption kinetics as well as amino acid composition. Carbohydrate ingestion following exercise is recommended when endogenous glycogen stores need to be replenished within a 24-hour time frame. In addition, many strength athletes often ingest large amounts of carbohydrate with protein during recovery from exercise to further augment post-exercise muscle protein accretion. However, coingesting such large amounts of carbohydrate does not necessarily enhance the muscle protein synthetic response when compared with casein.

Fig. 1. Dose-response relationship between the amount of protein ingested and post-exercise muscle protein synthesis rates (muscle fractional synthesis rate). Values represent means ± SEM. Means with different letters are significantly different from each other. Figure redrawn based on the work by Moore et al. [1].

Table 1. Practical recommendations for the athlete regarding dietary protein consumption during and/or after an exercise session

- Provide sufficient protein (20–25 g) with each main meal
- Ingest 20–25 g dietary protein during or immediately after an exercise session
- Whey forms an excellent source of dietary protein to promote post-exercise recovery
- Coingest carbohydrate based on the need to replete liver and muscle glycogen stores
- Coingest some protein during more prolonged exercise (~0.10 g/kg bodyweight per hour)
not further increase post-exercise muscle protein synthesis rates when ample protein is already ingested [4]. The timing of protein ingestion represents another important factor stimulating post-exercise muscle anabolism. A more direct provision of dietary protein following cessation of exercise has been shown to result in a more positive protein balance when compared with protein provided several hours after exercise. Furthermore, recent studies suggest that protein ingestion prior to and/or during exercise may further augment post-exercise muscle protein accretion. The latter has been attributed to a more rapid supply of amino acids to the muscle during the acute stages of post-exercise recovery. In addition, recent work also shows that protein ingestion prior to and/or during exercise already stimulates muscle protein synthesis during exercise, thereby creating a larger timeframe for muscle protein synthesis to be elevated [5]. Future research should focus on the relevance of the acute anabolic response following exercise and the importance of the timing of dietary protein provision as a means to further optimize the skeletal muscle adaptive response to more prolonged exercise training.

References