Nutrient-training interactions for maximising adaptation in skeletal muscle

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Physical activity and nutrition have profound effects on human health and metabolism. For example, prolonged periods of sedentary behaviour and/or nutrient over-provision can generate increased adiposity and a myriad of maladaptation. Chronic energy restriction and physical inactivity may also have the capacity to induce unfavourable adaptation responses in conditions such as aging or disease. For the athlete, nutrition and training are complimentary stimuli whose interactions are the foundation for adaptation in skeletal muscle that is a key determinant of an individual's capacity for athletic performance.

Skeletal muscle mass is controlled by the constant metabolic processes of protein synthesis and breakdown and their equilibrium results in a balance of protein turnover and consequently maintenance of muscle mass. The combination of exercise and amino acids is a potent stimulator to enhance muscle protein synthesis. Availability of essential amino acids during recovery from exercise is an important factor for promoting the anabolic response and adaptation in muscle. However, a number of factors including the type, quantity and timing of protein ingestion can modulate translation initiation signalling in skeletal muscle and subsequent rates of muscle protein synthesis. Other dietary factors such as "energy status" and substrate availability also have the capacity to alter the anabolic response in human skeletal muscle.

Different plasma amino acid concentrations are determined by the amino acid composition and digestibility of a food or meal (Burke *et al.*, 2012; Conley *et al.*, 2011). Manipulating the type and timing of protein intake could produce optimal plasma amino acid availability and maximal cell signalling responses for subsequent protein synthesis in skeletal muscle. Pasiakos *et al.* (2010) have also reported a 19% reduction in muscle protein synthesis in young healthy subjects after 10 days of energy restriction. It is currently unclear if the complimentary (anabolic) effects of exercise and protein ingestion on skeletal muscle protein synthesis are attenuated during periods of energy restriction.

Understanding nutrient-training interactions is critical for maximising the adaptation response to maintain or increase skeletal muscle mass. Determining the optimal combination of overall energy intake, amino acid provision and exercise stimuli is paramount for promoting adaptation in athletes and may also be important when developing countermeasures for sarcopenia with aging.

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