Strength Nutrition: Maximizing Your Anabolic Potential

Stephen Bird, PhD, CSCS
Exercise and Sports Science Laboratories, School of Human Movement Studies, Charles Sturt University, Bathurst, New South Wales, Australia

SUMMARY

THIS ARTICLE INTRODUCES COACHES AND STRENGTH/POWER ATHLETES TO THE CONCEPT OF STRENGTH NUTRITION AND PROVIDES A BRIEF OVERVIEW OF MECHANISMS THAT PROMOTES AN ATHLETE'S ANABOLIC POTENTIAL AFTER RESISTANCE EXERCISE AND CARBOHYDRATE, PROTEIN, AND/OR AMINO ACID INGESTION THROUGH THE PATHWAY OF ADAPTATION MODEL.

INTRODUCTION

The practical application of strength nutrition concepts (28), including liquid carbohydrate (CHO), protein (PRO), both whole foods (milk) and specific PRO fractions (whey and casein), amino acid constituents (essential amino acids [EAA] and branch chain amino acids [BCAA]), and mixed nutrient ingestion (CHO/PRO), has gained popularity. However, an expansive review by Hawley et al. (14), titled *Innovations in athletic preparation: Role of substrate availability to modify training adaptation and performance*, highlights the central question related to strength nutrition. That is, whether acute transient changes in skeletal muscle PRO turnover induced by nutrient manipulation after a single bout of resistance exercise translates into greater gains in lean mass, muscle hypertrophy, and/or exercise performance after chronic training. In an attempt to address this central question, a modified version of the "Pathway of Adaptation Model," previously described by Volek (29), is presented. This model provides a framework for fundamental steps that mediate acute responses to resistance exercise associated with strength nutrition and chronic muscular adaptations to training.

PATHWAY OF ADAPTATION MODEL

The Pathway of Adaptation Model describes strength nutrition concepts that mediate acute responses to resistance exercise and the chronic adaptations to training (29). However, 4 factors require consideration when determining the effectiveness of strength nutrition (Figure 1). The factors being

1. Exercise programming: what type, intensity, and duration?
2. Nutrient quantity: how much should be consumed?
3. Nutrient quality: what kind of nutrients should be consumed?
4. Nutrient timing: when should nutrient intake occur?

These factors are central to the Pathway of Adaptation Model and influence the sequence of events responsible for exercise-induced muscle growth and increased strength expression after nutrient ingestion. The interactions of 4 key steps in the acute response appear to be critical because this represents the "anabolic window" where strength nutrition maximizes an athlete's anabolic potential (Figure 2). There is growing evidence (3,4,8,22,26) suggesting a link between strength nutrition key nutrients (CHO and PRO/AA) and the Pathway of Adaptation Model after resistance exercise. While much of the research has centered on pre- and/or postexercise ingestion (8,13,27), ingestion during the exercise bout (2,3) is an important consideration for strength and power athletes because this represents a specific period where nutrient status becomes compromised because of training in the fasted state.

CARBOHYDRATE INGESTION

Liquid CHO ingestion during and/or after resistance exercise has been examined based on 3 primary outcomes, these being: (a) glycogen resynthesis, (b) hormonal modification, and (c) net muscle PRO balance. First, liquid CHO ingestion before exercise may reduce muscle and liver glycogen loss associated with an acute bout of resistance exercise, and this may be of importance for athletes involved in multiple training bouts per day (13). Second, liquid CHO ingestion during the exercise bout may shift the exer cise-induced hormonal milieu toward a profile more favorable for anabolism (26). Specifically, it is the response of insulin and cortisol that has received much attention (2) because these

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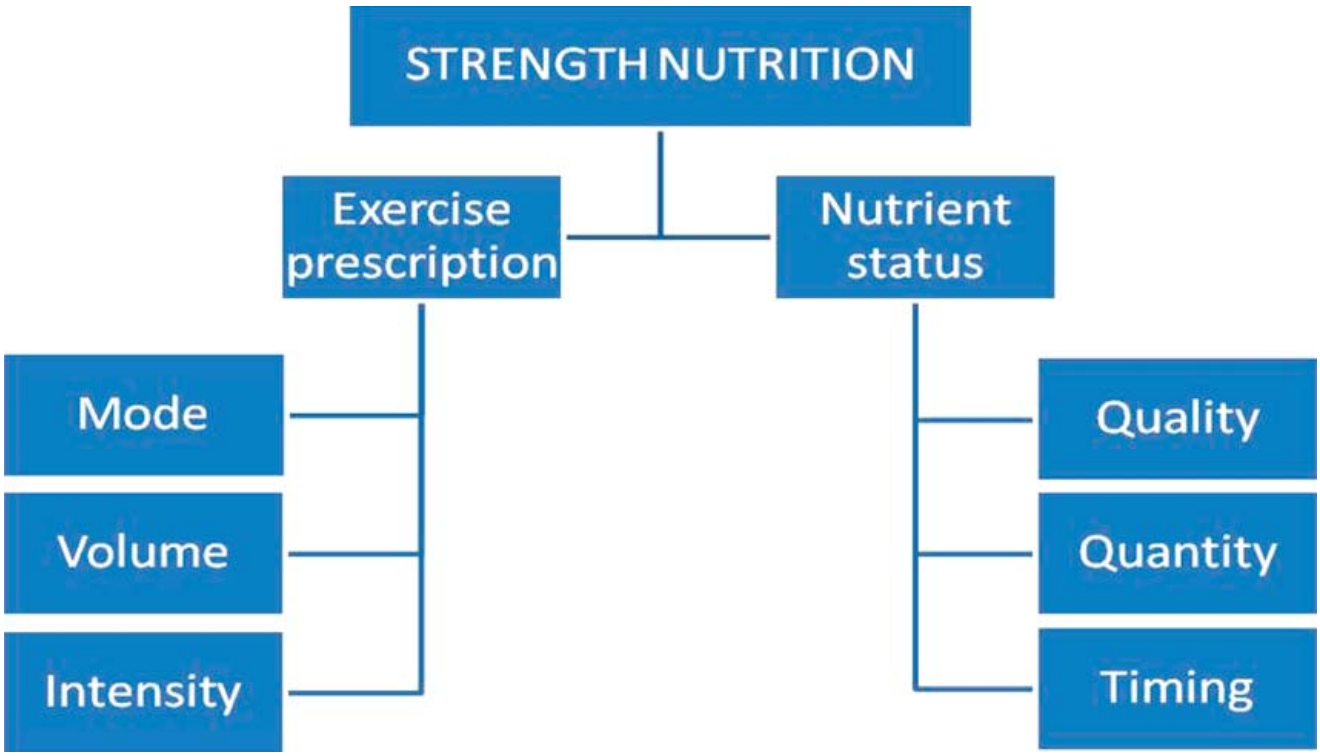

Figure 1. Key factors influencing strength nutrition.

hormones have major regulatory roles in CHO metabolism and PRO turnover. The CHO concentration appears to be an important regulator of the rate of gastric emptying. For example, a 20% CHO solution is reported to be significantly slower than a 6% CHO solution (20), and this will affect the acute hormonal response. Finally, CHO ingestion after exercise has been reported to improve net muscle PRO balance after resistance exercise (5). However, such an effect is considered minor when compared with the effect of AA ingestion (6) or combined CHO/AA ingestion (4). Therefore, liquid CHO ingestion in the form of a 6–8% CHO solution before exercise and/or during the exercise bout may enhance anabolic potential and exercise performance. Ingesting the CHO in liquid form may reduce the gastric emptying difficulty associated with whole foods, as well as providing a more convenient and practical alternative to whole-food ingestion.

PROTEIN/AMINO ACID INGESTION

Protein/amino acid ingestion before and/or after resistance exercise has an additive effect on muscle protein synthesis (MPS) (7,27), with small amounts (approximately 6 g) of amino acids, particularly BCAA (leucine, isoleucine, and valine) suggested to exert anticatabolic effects by not only promoting MPS (19) but also inhibiting intracellular proteolytic pathways (17). The anabolic/anticatabolic properties of BCAA initiate enzymatic activity responsible for switching on the molecular machinery responsible for MPS and muscle protein breakdown (MPB). Of the BCAAs, leucine seems to be the most potent (17) in modifying the expression of target genes at the level of transcription, messenger RNA stability, and translation, and this involves the integration input from multiple upstream pathways (10,11). From an anabolic perspective, recent reports (9,10,12) suggest that the signaling network controlling MPS is mammalian target of rapamycin (mTOR), an enzyme protein that act as a part of signaling pathway within a cell responsible for sequential activation of further signals activating MPS (i.e., telling cells to grow). Data by Dreyer et al. (9) suggests that acute increase in AA availability (particularly leucine) within the muscle, rather than insulin, is the major regulator of MPS. Specifically, leucine-enriched CHO/EAA ingestion after resistance exercise enhanced mTOR signaling with MPS increased by 145% above baseline, whereas an increase of only 41% was measured in subjects who performed the exercise without nutrition.

Conversely, the proteolytic system responsive to catabolic stimuli and MPB is the ubiquitin-proteasome pathway

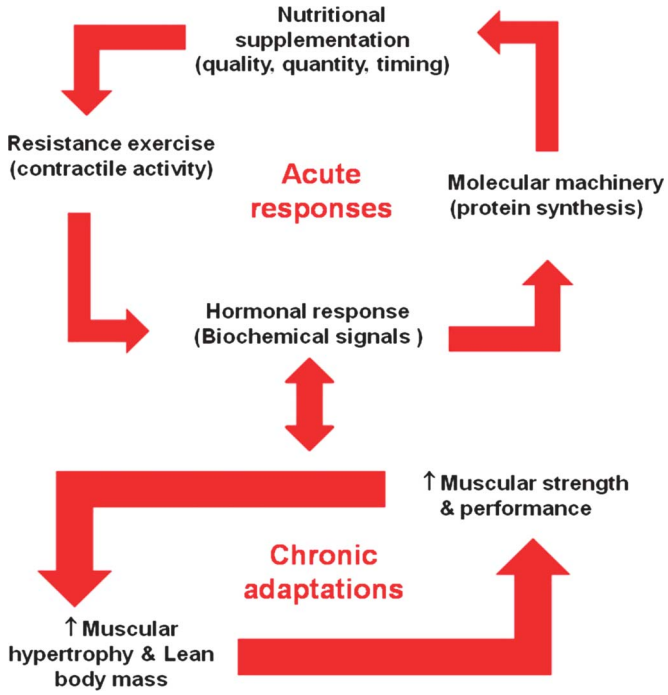

Figure 2. Key components of the Pathway of Adaptation Model play an interactive role in mediating the acute response to resistance exercise and chronic muscular adaptation to training.

(18,21) (i.e., tagging muscle proteins to breakdown). Leucine ingestion specifically may impact the components of both these signaling networks. Therefore, the interplay between PRO and AA ingestion on PRO kinetics (MPS and MPB) after resistance exercise is suggested to be a major determinant for the hypertrophic response of skeletal muscle (1), resulting in greater gains in both muscle mass and strength expression.

Koopman et al. (15) further highlight the importance of PRO/AA ingestion during the postexercise recovery period. The authors outline 2 crucial points, regarding PRO/AA ingestion. First, ingestion of PRO/AA during the postexercise recovery period is necessary for hypertrophy to occur; second, athletes need to ingest PRO/AA to attain positive PRO balance and maximize the muscle adaptive response. The type and timing of PRO/AA ingestion significantly affect both muscle growth and exercise performance. Therefore, provision of these nutrients immediately before, during, and after strength exercise is critical to the net PRO response in muscle (1).

FAT INGESTION

Of the macronutrients, fat, in particular, has been shown to beneficially or adversely affect testosterone response. Research indicates that consuming a low-fat diet and replacing saturated fat with polyunsaturated fat decreases basal testosterone levels (24,30). Volek et al. (30) report significant positive correlations between testosterone and fat intake (percent of energy consumption) in young strength-trained men. Furthermore, Sallinen et al. (24) suggest that diets with insufficient fat compromise the anabolic hormonal profile. Therefore, a moderate level of fat intake (20–30% of daily caloric intake) is recommended for strength athletes (16,25), with the majority of dietary fat obtained through monounsaturated (10–15% of daily caloric intake) and polyunsaturated (10–15% of daily caloric intake) fats, with small amounts of saturated fat (<10%) (25).

SUMMARY

Strength nutrition describes nutritional supplementation strategies centered around exercise aimed at promoting muscular adaptations to resistance training by shifting the anabolic/catabolic profile toward a profile more favorable for muscle growth (3,8), with nutrient ingestion suggested to be essential for hypertrophy to occur (15). Nutrient quantity, nutrient quality, and nutrient timing are key strength nutrition concepts that impact upon the effectiveness of nutritional supplementation strategies to enhance training responses for strength and power athletes through the Pathway of Adaptation Model. Preexercise ingestion of a fast-acting PRO (whey), CHO/EAA consumption during the exercise bout, and postworkout ingestion of a combined PRO blend (whey/casein) will promote an anabolic environment aimed at optimizing exercise-induced skeletal muscle growth. Whole-food ingestion 30 minutes after workout at a ratio of 1 g/kg CHO to 0.5 g/kg PRO is recommended, with a high-CHO meal within 2 hours after completing the workout (23). Therefore, strength nutrition may be the most important component of a strength and power athlete's training process, allowing the athlete to maximize anabolic potential.

KEY POINTS

1. The magnitude and duration of changes in nutrient status determine the anabolic effects on skeletal muscle.
2. Ingestion of BCAAs (leucine, in particular) produces an acute response on both MPS and MPB.
3. Mixed nutrient ingestion (CHO/PRO) is pivotal in enhancing hormonal responses and enhancing muscular performance.
4. Strength nutrition strategies centered on preexercise, during the exercise bout and postexercise period ensure that you are providing the essential nutrients required to optimize the training response.

Stephen Bird *is the senior advisor, Strength and Conditioning, Sports Science Division, Program Atlet Andalan, Indonesian Elite Athlete High Performance Program through the School of Human Movement Studies, Charles Sturt University, Bathurst.*

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