Point/Counterpoint

The purpose of the Point/Counterpoint Column is to provide a respectful and balanced discussion in relation to controversial or current topics in the fields of strength and conditioning, nutrition, and human performance.

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The Timing of Postexercise Protein Ingestion Is/Is Not Important

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ABSTRACT

PROTEIN CONSUMPTION IS UNQUESTIONABLY REQUIRED FOR SKELETAL MUSCLE MAINTENANCE AND GROWTH. HOWEVER, DEBATE PERSISTS OVER WHETHER OR NOT THE TIMING OF INGESTION MATTERS. SOME ARGUE IMMEDIATELY AFTER EXERCISE IS BEST, WHEREAS OTHERS DISAGREE. THIS ARTICLE WILL DISCUSS THE IMPORTANCE OF TIMING OF POSTEXERCISE PROTEIN INGESTION.

PRO

Although protein synthesis is typically elevated after exercise, protein degradation is also increased resulting in a negative net protein balance, and this catabolic state will prevail for many hours unless actions are taken to shift the body into a predominately anabolic state (2–4,7). To make this metabolic shift, nutrient intervention is required. By ingesting carbohydrate and protein soon after exercise, glucose and amino acids derived from these macronutrients initiate a shift from a catabolic state to an anabolic state by raising blood insulin levels, lowering cortisol and other catabolic hormones, and increasing substrate availability (4,7). Because muscle is highly insulin sensitive after exercise and there are increased concentrations of glucose (16,33) and amino acid transporters (23) on the sarcolemma, which ensure the rapid uptake of blood glucose and amino acids, muscle glycogen storage and protein synthesis are promoted. The increase in insulin is also important for limiting protein degradation. Since insulin sensitivity declines with time after exercise as well as the number of glucose and amino acid transporters associated with the sarcolemma, the effectiveness of nutrient intervention will also decline (21,24). Therefore, making the appropriate nutrients available around the exercise period can increase the rate of protein synthesis and reduce protein degradation, thereby increasing protein accretion (24,25). However, research suggests the magnitude of these responses will be significantly reduced if supplementation is delayed for several hours.

Evidence supporting this concept comes from both acute and chronic exercise studies. For example, Levenhagen et al. (24) and Okamura et al., (25) reported that providing an adequate protein or amino acid supplement immediately after exercise significantly raised the rate of total body and muscle protein synthesis as compared with delaying supplementation for several hours. In well-controlled resistance exercise training studies, supplementing in proximity to the workout as compared with delaying supplementation was found to enhance muscle development and strength (5,10,12,20,32). Gains in lean body mass, muscle fiber cross-sectional area, and strength with nutritional supplementation after resistance exercise have been reported to be 40–120% (5,10,17,22,32), 50–300% (5,10,17,30), and 30–100% (5,8,10,12,22,32) greater, respectively, verses providing no supplement or supplementing at a later time of day. In some studies, only when supplementing protein after exercise were significant increases in fat-free mass and strength noted (12,19). Moreover, increased aerobic training adaptations with postexercise supplementation have also been reported (13,26).

In several studies, the results indicated there was no advantage to providing postexercise nutritional supplementation when performing resistance exercise (11,18,29,31). A recent meta-analysis also concluded that postexercise nutritional supplementation only had a marginal effect on muscle hypertrophy and no significant effect on strength development (28). Instead, it was suggested the increase in muscle mass and strength were more closely aligned with the total amount of protein consumed per day. Although well conducted, this analysis had several limitations that could have significantly influenced the outcome. These included eliminating several studies with positive effects from the analysis because a maximum effective amount of protein was not used (12,19) and incorporating studies that did not have a true placebo for the postexercise supplement or did not restrict food consumption during the immediate hours after exercise (11,15,18,27). In addition, the effect of nutrient timing on muscle hypertrophy and strength adjusted for total daily protein consumption was based on self-reported dietary recalls, which in most studies were performed only once or twice during the course of the study, and with the majority of studies indicating no difference in total daily protein consumed across treatment groups.

Although it is relatively clear that nutrient supplementation around a workout can reduce exercise-induced muscle damage and inflammation, increase the rate of muscle glycogen stores, and enhance the rate of recovery (1,5,6,9,14), its effect on resistance exercise training adaptations is less definitive. This is due in part to the lack of research studies actually designed to address this question. However, results from a few well-controlled studies strongly suggest that stimulation of protein accretion and resistance training adaptation is better served by provision of nutrients sooner rather than later after exercise.

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CON

Protein timing has been promoted as an important strategy to maximize muscular adaptations from resistance training. The strategy is predicated on the concept of an "anabolic window of opportunity" whereby it is postulated that working muscles are primed for anabolism for a limited time after resistive exercise, and amino acids therefore must be consumed within this window to maximize exercise-induced muscle protein accretion (4,8,10). According to theory, the anabolic window extends only about 1 hour after exercise, and delaying protein consumption beyond this point will ultimately have a negative impact on results (9). Proponents have even proposed that the timing of consumption may be more important than the absolute daily intake of nutrients (4). A recent review of literature by Aragon and Schoenfeld challenged the veracity of such claims; however, concluding that evidence in support of a narrow anabolic window is weak and based on a flawed extrapolation of current research (1).

The genesis of the anabolic window theory can be traced to acute protein timing data that suggested a benefit to immediate versus delayed postexercise nutrient intake. Early work by Okamura et al. (15) showed that muscle protein synthesis (MPS) was higher when dogs were infused with a protein/glucose solution immediately versus 2 hours after long-duration treadmill training. Subsequently, human research by Levenhagen et al. (13) found that immediate administration of an oral supplement containing 10 g of protein after 60 minutes of bicycle training resulted in a 3-fold greater increase leg MPS compared with delaying provision for 3 hours. Follow-up work by the same group showed that ingestion of a 10-g protein supplement combined with carbohydrate immediately after cycling resulted in a net leg uptake of essential amino acids and net whole-body and leg muscle protein gain, whereas consumption of carbohydrate alone and placebo resulted in a net leg release of essential amino acids and net loss of whole-body and leg muscle protein (12). Although these studies would seem to lend support to the anabolic window theory, it should be noted that all involved moderate intensity aerobic-type training. This raises the distinct possibility that results were largely attributed to greater mitochondrial and/or sarcoplasmic protein fractions as opposed to synthesis of contractile elements (18). In contrast, Rasmussen et al. (16) found that consumption of an oral supplement containing 6 g of essential amino acids after resistance training produced similar increases in MPS irrespective of whether the supplement was ingested 1- versus 3 hours after exercise. Importantly, the acute protein synthetic response to exercise does not always occur in parallel with chronic upregulation of causative myogenic signals (5) and is not necessarily predictive of long-term increases in muscle hypertrophy pursuant to regular resistance training (14).

A recent meta-analysis from the author's laboratory sought to quantify the effect of protein timing on muscular adaptations by pooling data from longitudinal studies on the topic (17). A total of 23 studies comprising 525 subjects met inclusion criteria. A basic analysis that did not account for covariates showed a small but significant positive effect (effect size = 0.24 ± 0.10) for protein timing on muscle hypertrophy. However, meta-regression revealed virtually the entire effect was attributable to total protein consumption. Daily protein intake of the control subjects averaged 1.33 g/kg, whereas that of those in the timing condition was 1.66 g/kg. Given that research shows resistance-trained individuals require a protein intake of 1.6–1.7 $g \cdot kg^{-1} \cdot d^{-1}$ to remain in a non-negative nitrogen balance (11), it therefore follows that the protein-timed subjects had a distinct advantage as a result of meeting total daily protein needs to support anabolism.

A limitation of the meta-analysis was that only 3 studies meeting inclusion criteria endeavored to match protein intake between conditions (6,7,19). Mean protein intake in these 3 studies was 1.91 versus 1.81 $g \cdot kg^{-1} \cdot d^{-}$ for treatment and controls, respectively, indicating that both groups exceeded the threshold needed to optimize protein balance during resistance exercise. Of these studies, 2 of the 3 showed no benefits from timing (7,19) and another that did not meet inclusion criteria actually found a detrimental effect on lean body mass from consuming protein immediately around the exercise bout as compared with a time-divided protein dose (i.e., morning and evening) (3). In addition, only 2 protein timing studies exclusively involved resistance-trained subjects with 1 finding a beneficial hypertrophic effect (6) and the other showing no significant differences between treatments (7).

Based on the prevailing body of literature, it can be concluded that evidence in support of a narrow anabolic window is weak, at best; if immediate consumption of protein after exercise does in fact confer any positive hypertrophic advantage the effect would almost certainly be small. There is evidence that muscle is sensitized to protein consumption in the postworkout period, and that this sensitization can last for 24 hours or more after a resistance training bout (2). That said it remains possible if not probable that delaying protein provision for many hours postworkout would ultimately have a negative effect on muscle protein accretion. Extrapolation of data suggests that the "window of opportunity" likely extends at least 4–6 hours from the time a person consumes a meal before training (1). This hypothesis requires further study.

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