PROTEIN FOR MUSCLE RECONDITIONING

AN EXPERT REFRESHER

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In literal terms, the word protein is derived from the Greek language and means "holding first place". So, even since the times of Ancient Greece, protein has been associated with performance.

In exercise science, the importance of dietary protein for muscle reconditioning stems from the need to supply amino acids to the working muscles following exercise. These amino acids are derived from protein-containing sources and provide the building blocks of muscle protein.

Muscle proteins are continuously being remodelled. This means that old muscle proteins that are damaged during exercise are broken down, and new functional muscle proteins are built back up. Amino acids provide the brand new 'stock' required to make new functional muscle proteins following exercise.

Over the past 30 years, research has helped advance our understanding of the 3 T's: Total, type and timing of protein intake to promote muscle reconditioning[1]. Here, we consider how research on the 3 T's of protein relate to amateur athletes.

WHAT DO WE MEAN BY THE TERM "MUSCLE RECONDITIONING"?

Muscle reconditioning involves two metabolic processes. The first is muscle protein synthesis, or MPS. MPS describes the incorporation of amino acids from the dietary protein we consume directly into new muscle proteins. These muscle proteins include the contractile myofibrillar proteins that are most responsive to resistance-type training and determine the size of our muscles. Other muscle proteins include the energy-producing mitochondrial proteins that respond to endurance-type training and collagen proteins that provide structure to skeletal muscle[2].

The second metabolic process is muscle protein breakdown, or MPB, which occurs at the same time as MPS. MPB describes the breaking down of old damaged muscle proteins back into their original amino acid building blocks.

Both MPS and MPB are crucial for muscle reconditioning. That said, MPS is 4-5 times more responsive to protein consumption than MPB[3]. This is why protein recommendations for muscle reconditioning are often informed by studies that measure the optimum total, type and timing of protein ingestion for stimulating MPS.

THE 3 T'S: TOTAL, TYPE AND TIMING OF PROTEIN INTAKE TO PROMOTE MUSCLE RECONDITIONING

TOTAL

Current guidelines on the recommended daily protein intake for muscle reconditioning in weight stable exercisers range between 1.2 and 1.8 grams per kilogram body mass per day[4]. But what about exercisers with the goal of maintaining that hard earned muscle mass during a period of weight loss? The science tells us this group may benefit from higher protein intakes in the region of 2-2.4 grams per kilogram body mass per day. This is because energy restriction limits muscle reconditioning since MPS is an energetically expensive process. Therefore, additional daily protein is recommended to make up for this shortfall.

All that being said, sport nutrition guidelines routinely champion a more refined approach to devising protein recommendations for muscle reconditioning[5]. This means breaking down daily protein intakes on a meal-by-meal basis rather than on a total daily basis. We are beginning to understand that the optimal target protein dose for muscle reconditioning depends on several exercise- and nutrition-related factors. So, the amount of muscle mass activated during exercise[6], the mode of exercise[7], the source of protein consumed, and whether a follow-up protein feed is practical[8], will all impact the "sweet spot" for optimising the target protein dose. Age also matters, especially once we reach our 50's and beyond[9].

The early science suggested that 20-30 grams of protein is sufficient to maximise muscle reconditioning following a leg-only weight-lifting workout, aka the dreaded "leg day"[10,11]. Yet, recent research suggests that this target protein dose increases closer to 40 grams following a whole-body workout[6]. Presumably, the requirement to redistribute protein-derived amino acids to additional working muscles following a whole-body workout means that more protein can be used for MPS. And this advice seems to apply to young males and female exercisers alike[12]. So, a medium sized fillet of salmon, two pork tenderloins, 3-4 large eggs, 2 cups of chickpeas, or 1 large glass of chocolate milk represent just a selection of good options for post-exercise protein-rich foods. A food-first approach to protein nutrition applies irrespective of whether you are performing at the professional or grassroots level.

But what about endurance-type exercise? Or concurrent exercise that combines resistance and endurance-type exercise and is more applicable to team sport enthusiasts? Runners and cyclists should be more interested in remodeling mitochondrial muscle proteins that boost energy production than myofibrillar proteins that lead to muscle hypertrophy. Current research indicates that 30 grams of protein is sufficient to maximise muscle reconditioning following endurance-type exercise of a moderate intensity and duration[(7)], applicable to that weekend long run or steady cycle. But does this hold true for more arduous endurance workouts? The truthful answer is: We don't know.

We do know that 25 grams of high-quality protein boosts muscle reconditioning following concurrent exercise[13]. But again, it is too early to pinpoint with any scientific confidence the precise optimal protein dose for the team sport athlete.

So, when we throw all this science into the mix, what is the most solid evidence-based target protein dose recommendation for muscle reconditioning? The best answer is to target a per meal protein intake equivalent to 0.3 grams per kilogram body mass[9]. Clearly this recommendation is less intuitive than prescribing an absolute 20-, 25- or 30-gram protein dose. But it does allow the sport nutritionist to apply a single blanket recommendation across all athletes irrespective of individual body size. With a quick calculation, the 60 kg athlete is advised to consume approximately 18 grams of protein post workout compared with ~30 grams for the 100 kg athlete.

To keep things interesting, the science tells us to increase this per meal protein recommendation to 0.4 grams per kg body mass as we age above 50 years old[9]. This increase is proposed to override the so-called muscle anabolic resistance, meaning the impaired MPS response to ingested protein, associated with advancing age.

TYPE

The best choice of protein source for muscle reconditioning is often a hot topic in sport nutrition. Our nutrition textbooks tell us that high quality protein sources contain an abundance of all 9 essential amino acids and are rich in leucine. This is because leucine has two distinct roles in supporting muscle reconditioning. First, the appearance of leucine within the muscle cell signals a protein housed inside the muscle called mTOR to switch on MPS. Second, like all other amino acids, leucine acts as a building block for muscle protein.

Dairy has been studied more than any other protein source in the context of muscle reconditioning, and for good scientific reason. Dairy proteins contain all essential amino acids and have a higher essential amino acid content than human muscle itself. Plus, whey boasts a higher leucine content than all other protein sources. For instance, whey protein constitutes a leucine content of 13% whereas the leucine content of soy protein is only 8%[14]. So, it makes sense that ingesting a 20-gram dose of milk or whey protein after resistance exercise promotes a greater MPS response than soy. Recent studies have confirmed that cheese[15] and quark[16] represent other dairy products that are effective in stimulating MPS following resistance exercise in recreationally active young men.

For amateur athletes who play team sports, the protein source may matter less. A recent study looking at concurrent exercise reported no differences in MPS following ingestion of 20 grams of milk, whey or casein protein[17]. So, the impact of protein source on muscle reconditioning in exercisers from team sports appears to be limited, at least when ingested as a meal-like 20-gram dose. Of course, more work is needed to confirm this claim.

When it comes to plant proteins, the original assumption was that they are inferior to animal proteins in promoting muscle reconditioning given that plant proteins are deficient in at least 1 of the 9 essential amino acids (typically, lysine or methionine). Plus, with few exceptions, plant proteins consist of a lower leucine content[14].

However, based on recent findings, we appear to have underestimated the role of plant proteins in muscle reconditioning. Potato protein was shown to stimulate MPS following resistance exercise in recreationally active young males[18] and females[19]. Somewhat surprisingly, 30 grams of ingested corn[20] and pea[21] protein stimulated a comparable MPS response to milk protein. And a comparable MPS response to mycoprotein[22] and algae[23] as alternative proteins *vs*. milk ingestion have also been reported. It is important to highlight that MPS was measured at rest rather than post-exercise in several of these studies. Nonetheless, the evidence suggests that plant proteins can promote muscle reconditioning just as effectively as animal proteins. At least when ingested at moderate-to-high protein doses.

TIMING

We've all probably come across the "anabolic window of opportunity" concept in our academic training which promotes the concept that protein 'should' or even 'needs' to be ingested within a 60-minute window post-exercise for muscle reconditioning. Some advocates have even narrowed this window down to just 45 minutes post workout[24].

Yet the practical relevance of this "anabolic window" theory is clearly context-specific. Yes, there might be some merit behind the "anabolic window" with regards to maximising muscle reconditioning for the elite athlete. But a strong argument can be made that the importance of protein intake within this short timeframe following exercise is not as critical as is often publicised, particularly for the recreational sport and exercise enthusiast. Instead, it can be argued that the "anabolic window" for protein intake – as defined above – should be extended beyond only the first hour (or less) post workout.

Advocates of the "anabolic window" theory often cite findings from a resistance training study in young men that was performed over a 10-week period[25]. Volunteers that consumed protein immediately before and after each workout reportedly gained more muscle mass than volunteers that consumed protein early in the morning and late at night. However, these findings have not been replicated in follow-up studies[26].

In fact, one study found a greater increase in muscle mass after 8 weeks of training when protein was consumed 6 hours before and 5 hours after training compared with 6 hours before and immediately pre training[27]. So, these findings cast into doubt the importance of immediate post-exercise ingestion of protein for muscle reconditioning. Difficulties in controlling several other potentially influential factors over an extended time period, such as overall diet, habitual physical activity levels, etc, have likely contributed to these inconsistent results.

In contrast, controlled laboratory studies report a similar degree of muscle reconditioning after consuming an essential amino acid mixture 1, 2 or even 3 hours post exercise[28,29]. Plus, research has demonstrated that protein intake 24 hours post workout resulted in greater MPS rates compared with protein intake with no exercise[30]. So, skeletal muscle remains responsive to protein ingestion during time periods outside the limits usually defined by the "anabolic window." In fact, it appears that this "anabolic window" extends to 24 hours post workout, or perhaps even longer.

Clearly, the appropriate timeframe to consume protein after exercise for muscle reconditioning need not be restricted to a 45-60-minute window post-exercise, particularly in recreationally active individuals as opposed to elite athlete.

TAKE HOME POINTS

- The 3 T's of protein nutrition (Total, Type and Timing) are key considerations for muscle reconditioning following exercise.
- Target a protein dose of 0.3 grams per kilogram body mass per serving.
- Dairy proteins stimulate a robust muscle protein synthesis (MPS) response following exercise. Plant proteins also stimulate a robust MPS response following exercise assuming a full complement of all 9 essential amino acids are derived from multiple plant protein sources.
- The proposed "window of anabolic opportunity" is not relevant for recreationally active sport and exercise enthusiasts in terms of promoting muscle remodelling. The MPS response to protein intake remains elevated for up to 24 hours post-exercise.

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