One whey to go for exercise performance recovery

Whey Protein Supplementation Enhances Whole Body Protein Metabolism and Performance Recovery after Resistance Exercise: A Double-Blind Crossover Study.

Introduction

Anyone who has ever worked out has experienced some degree of muscle soreness afterward. One reason why this occurs is due to muscle fiber damage after exercise, which results in varying degrees of soreness and decreased performance that can last hours or days. The degree to which performance may decrease depends on the workout volume and intensity. An acute performance drop is a normal consequence of any training program. But for athletes, minimizing and quickly resolving these negative effects of training can help increase the amount of total training time. The more time an athlete can spend training, the better their chances are at improving in their respective sport.

One strategy for improved muscle recovery is to ensure you're getting enough dietary protein to meet your physical activity demands. The thinking is that increased protein leads to increased positive protein balance (i.e. greater protein synthesis than breakdown) in the body, in turn resulting in more rapid recovery of muscle performance. While it's important to get adequate amounts of protein in your diet, there's more to protein than just consuming enough to help achieve your fitness goals. There are many strategies that can help maximize protein's muscle-repairing effects. When paired with resistance training, protein has been shown to help increase muscle size and strength. Ingestion before or after training may theoretically provide further benefit (although this benefit may be mitigated by consuming sufficient protein during your day). Evenly distributing protein intake between meals can further augment its anabolic effects. Consuming protein before you go to bed may also cause a slight improvement in muscle protein synthesis (MPS) while you sleep. The type of protein is also important to amplifying the muscle protein synthetic response. For example, a rapidly digesting, leucine-rich, highly bioavailable whey protein has been seen to help boost MPS, making whey a preferable supplement for people aiming to maximize recovery and adaptations to resistance exercise.

The above strategies are often used by athletes in conjunction with one another. In fact, there is data to support the beneficial effects of protein supplementation on long-term improvements in muscular adaptations. But less research has been done looking at how post-exercise protein ingestion may aid recovery acutely (e.g., less than 24 hours). The study under review aimed to quantify the extent to which post-workout protein supplementation could improve muscle performance recovery after a bout of strenuous resistance exercise.

It is important for athletes to minimize the acute negative effects of training to help maximize total training hours. One way to accomplish this requires strategic intake of protein: consuming enough of it and at the right times. Many studies have looked at the long-term effects of protein consumption on muscle repair, but fewer have looked at its effects in an acute period. This study looks to quantify the effect of supplemental protein on muscle performance post-exercise.

Who and what was studied?

The primary research outcome of this study was to determine if consuming a whey protein supplement right after resistance training could enhance whole body net protein balance 10 hours after exercise. Two secondary aims were also investigated. The first was to assess differences in muscle damage repair between groups. The second was to determine if whole body net protein balance could be further enhanced and extended to the 24 hour mark by taking another protein serving 10 hours after the post-exercise one. The scientists conducting this trial hypothesized that protein supplementation would "enhance net protein balance at 10 and 24 hours of recovery, primarily by enhancing protein synthesis, and that this response would be associated with greater indices of exercise performance."

Twelve healthy young men (76 ± 8 kg, 24 ± 4 years old, 14% ± 5% body fat) who were resistance-training two to four times a week for at least six months were enrolled into the study. Participants were excluded from the study if they had consumed supplements in the last three weeks or were on medication that could affect protein metabolism.

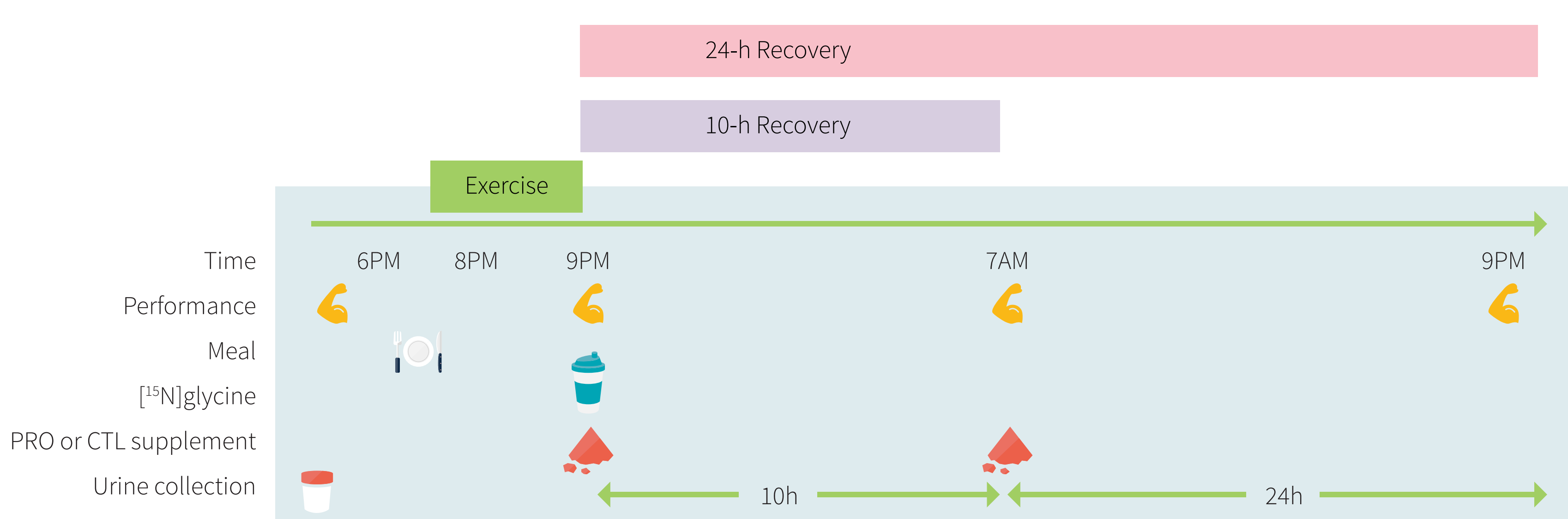
This double-blind, placebo-controlled, crossover study was comprised of three phases. Over the first two phases, participants undertook a whole-body resistance exercise program in the evening (about 8 p.m. to 9 p.m.). They then received either 25 grams of whey protein (whey protein blend with 2.4 grams of leucine) or a calorie-matched carbohydrate placebo immediately post-exercise and again 10 hours later. Subjects who had randomly been chosen to receive protein in the first part would receive the placebo in the second and vice versa. The trials were separated by a one week washout period.

A third and final phase was conducted that had no exercise or supplement component, to serve as the control for the first two. In all three, performance measures were taken at four time points as shown in Figure 1. These were used to assess the secondary outcome of how different supplements affected the repair of exercise-damaged muscles and included the following tests:

- Countermovement jump (similar to a jump squat) to assess neuromuscular fatigue
- Knee extension isometric maximal voluntary contraction to assess static strength/muscular endurance
- Knee extension repetitions to failure at 75% of 1 Rep Max (1RM) to assess dynamic strength/muscular endurance
- A 30 second Wingate test to assess anaerobic power output

Participants were on a controlled diet that was prepared and provided to them by a registered dietitian over the course of all three two-day trial periods to keep macronutrients and calories consistent with the athletes habitual intake. Diets were formulated to mimic participants' typical intakes as to not introduce further confounding variables. But this also means that participants were not matched for total protein intake which, ironically, could be a confounding factor. The average daily protein intake was 1.9 grams per kilogram of bodyweight per day (average total intake of 143 ± 16 grams/day), which is on the higher end of protein intake. The whole-body resistance exercise program involved a series of supersets (barbell bench press plus pulldowns and barbell overhead press and seated row) plus two isolation exercises (leg press and leg extension). The workout scheme was four sets of 10

Figure 1: Study Design



reps at 75% of their 1RM with two-minute rest intervals between sets.

To help measure protein balance, participants were given a dose of glycine, an amino acid, immediately post exercise. This particular type of glycine had been labeled with radioactive nitrogen to track its whereabouts in the body. The radioactive amino acid enables the measurement of whole body protein synthesis, protein breakdown, and net protein balance over short time periods. Researchers then measure the amount of radioactive nitrogen excreted in urine as ammonia and urea. By comparing the amount of the radiolabeled glycine that was ingested relative to radioactivity in the ammonia and urea (both byproducts of protein breakdown), the net protein balance was estimated. An oversimplified way of thinking about it is:

Glycine Ingested – Glycine Excreted = Whole Body Protein Balance

The whole process is more complex than the above equation would suggest, but it should give you a general idea of how this testing method works. If you want to learn more about this method, check out this open access review paper.

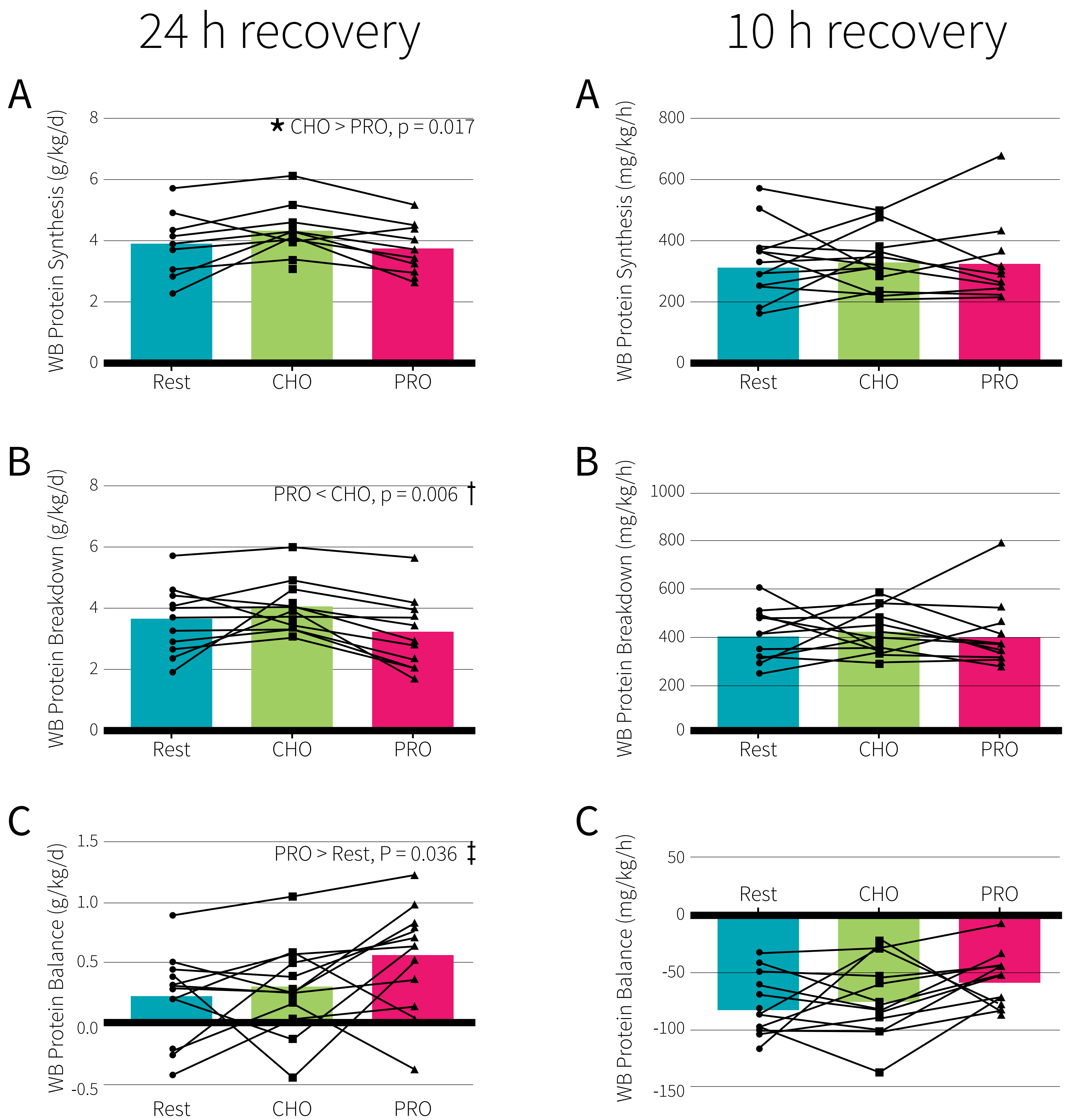
The aim of this study was to determine if a whey protein supplement could enhance whole body net protein balance 10 and 24 hours after exercise. A radioactively labeled glycine supplement was ingested by the participants to help measure changes in protein synthesis over these time periods. Exercise tests were also conducted to see if the protein supplement could increase exercise performance.

What were the findings?

The authors reported some of their results as standardized effect sizes (specifically, Cohen's d for stat nerds out there). Standardized effect sizes are a way to report the size of effects that may be measured differently. Thresholds for small, moderate and large effect sizes are 0.2, 0.5 and 0.8, respectively. At the 10-hour post-exercise mark (the primary endpoint), net protein balance was negative (i.e. protein breakdown was greater than synthesis) among all groups after their overnight recovery as seen in Figure 2. While not statistically significant, the calculated effect size of 0.61 indicates a medium effect of protein over the no exercise/supplement control trial. But the lack of statistical significance raises the question of whether this effect size is accurate. At the 24-hour post-exercise mark (a secondary end-

> “The average daily protein intake was 1.9 grams per kilogram of bodyweight per day (average total intake of 143 ± 16 grams/day), which is on the higher end of protein intake.”

Figure 2: Results



point), net positive protein balance was enhanced in the protein group (effect size = 0.69), but not in the carbohydrate group. This effect was statistically significant.

In terms of exercise performance recovery (another secondary endpoint), performance significantly decreased across all tests at the immediate post-exercise testing session compared to baseline. Countermovement jump height decreased ~12%, maximal voluntary contraction decreased ~20%, knee extensions to failure dropped ~19%, and both peak and average anaerobic power in the Wingate test were reduced by ~7%.

When looking at the effect sizes of the exercise test at the 10- and 24-hour marks, researchers found a small-to-moderate beneficial effects in the protein group on countermovement jump height, maximal voluntary contractions, and anaerobic power during the Wingate test. At 24 hours, moderate benefit from protein supplementation was seen in maximal voluntary contractions, knee extension repetitions to failure, and peak power for the Wingate.

Curiously, no correlations were apparent between net protein balance and maximal voluntary contractions, knee extension repetitions to failure, or Wingate power (peak or mean).

After a bout of resistance training, ingesting a pre-sleep protein supplement did not attenuate negative protein balance during sleep. When an additional dose of protein was ingested the next morning, a positive protein balance was observed 24-hours post-exercise. Protein supplementation also improved exercise performance recovery to a small or moderate amount 10 or 24 hours after the exercise bout. However, net protein balance did not correlate with recovery of exercise performance.

What does the study really tell us?

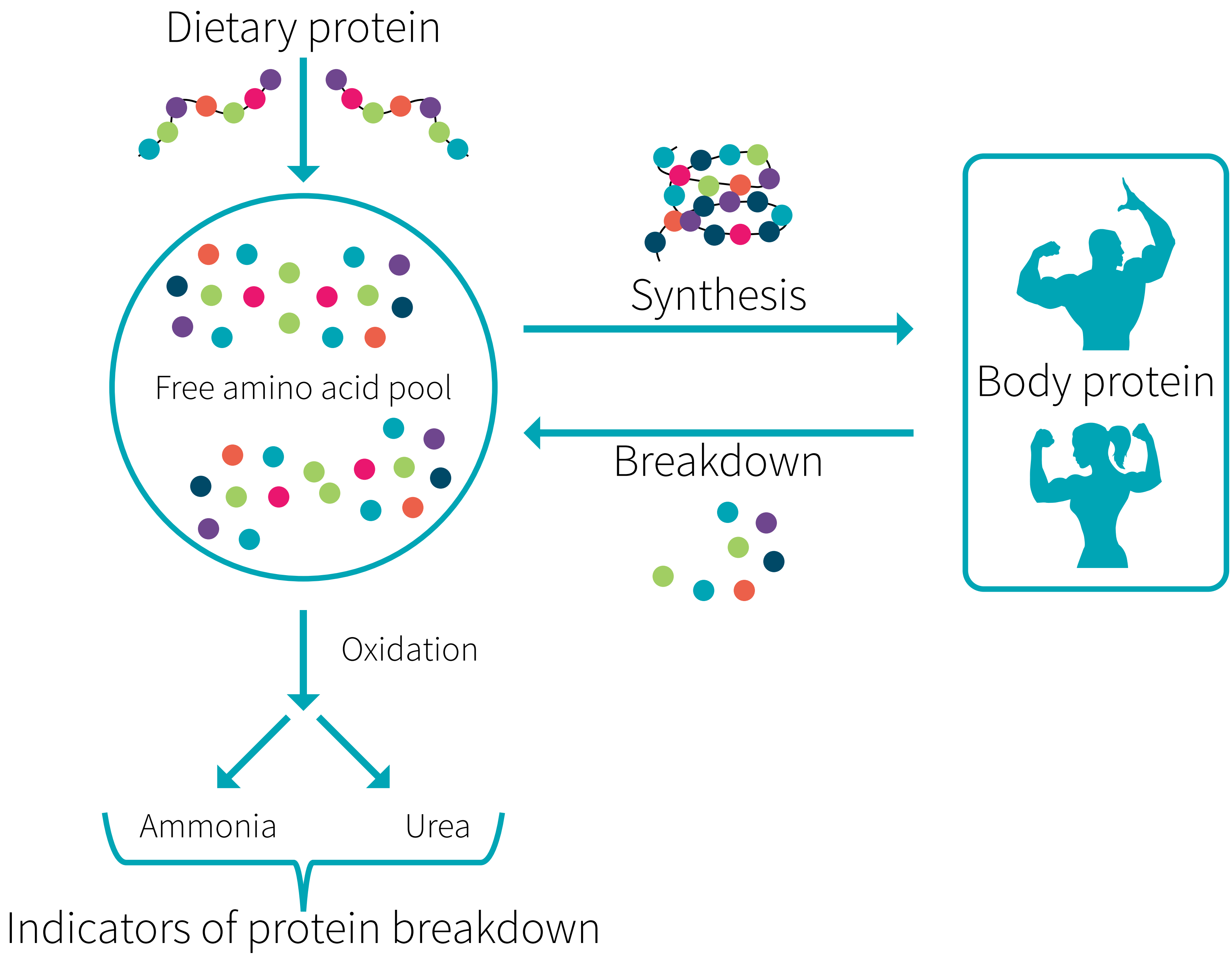
Contrary to the authors' hypothesis, whole-body net protein balance was not significantly augmented with a protein supplement over the 10-hour post-exercise recovery window compared to carbohydrate. However, the protein group did see better protein balance results at the 24-hour mark - possibly due to a synergistic effect of the protein timing plus the total amount of protein supplemented.

It is possible that the type of protein given was suboptimal for generating positive protein balance. Whey protein is digested and utilized by the body very quickly, whereas a casein or whey plus casein combination may have extended the time participants spent in an anabolic state overnight. Also keep in mind the participants had a habitual daily protein intake of about 1.9 grams per kilogram of bodyweight per day *before* the supplement was added on top of that. This is on the high end of what is typically recommended to athletes (about 1.2 gram to 2.0 grams per kilogram per day), so another possibility is that the anabolic effect of protein may have been blunted due to the athletes' already high protein intake (a.k.a the 'ceiling effect').

The protein supplement group did see a moderate improvement in performance recovery at the 10- and 24-hour marks. This is likely due to the greater protein intake mediating increased protein synthesis, as evidenced by the greater 24-hour net protein balance seen in the protein supplement group. While this acute change in protein balance and performance recovery may not seem like much, repeated acute improvements in protein balance may lead to long-term increases in muscle mass over time. However, this concept needs further evaluation as acute changes over a 24-hour period are not always predictive of long-term results.

One curiosity of the study was the lack of association between 10- and 24-hour whole body net protein balance and changes in performance compared to the post-exercise performance tests. This may be due in part to the way protein balance was measured. While the researchers were looking at whole body protein balance, skeletal muscle turnover, depicted on the right-hand side of Figure 3, only contributes to about 30% of this. This may have prevented the model used by the researchers to detect, with sufficient precision, the net muscle protein balance from the whole-body glycine tracer used in the study. Alternatively, it is possible that a dose-response relationship for muscle and/or whole body protein balance towards performance recovery does not exist, in which case inducing some as yet undetermined minimum net anabolism may be sufficient to enhance or maximize performance recovery. This is one aspect that will have to be studied in further trials, though.

Figure 3: Protein turnover



This study had some notable strengths. While the initial power calculation called for only 10 participants, the researchers enrolled 12, all of whom completed each trial. Compliance with the prescribed diets was very high, with participants consuming 98.4% of the calories and 98.4% of the protein provided. The study's blinding procedures were rigorous as well—only one of 12 participants correctly identified which supplement they were taking during all arms of the trial. Finally, the order of the exercise tests was set up from the least to most strenuous, with adequate rest periods in between. This helps minimize any carryover effect from fatigue that may bias the results.

It should be noted that funding and consultation for the study design were provided by Iovate Health Sciences International Inc. Iovate owns the brand MuscleTech, whose whey protein was used in this study.

Protein supplementation did not improve whole-body net protein balance at the 10-hour post-exercise recovery window, but did so the 24-hour mark. The participants already high daily protein intake may have attenuated any additional benefit of protein, or a larger dose of protein may be needed. While there were no statistically significant associations between 10- and 24-hour whole body net protein balance and changes in performance, this may have been due to a lack of sensitivity to measure muscle protein balance, which accounts for about 30% of whole body protein balance.

The big picture

This study contributes to a growing body of evidence that milk-based proteins consumed after exercise can preserve muscle strength and attenuate decreases seen in repeated sprint challenges up to three days after exercise. The present study complements these findings by demonstrating that whey can enhance muscle performance as early as 10 hours into the post-exercise recovery window and extending up to the 24 hour mark.

The mechanisms of improved markers of exercise performance with whey protein ingestion are not fully understood. It has been hypothesized that the greater muscle protein synthesis and repair driven by protein supplementation may facilitate a quicker performance recovery, although evidence backing this hypothesis up is lacking. It's also possible that the essential amino acids in protein supplements may attenuate inflammation, soreness, and muscle damage, which could also positively influence performance tests.

The study contributes to a body of evidence indicating milk-based proteins may aid in muscle recovery and preserve strength - something that would be of particular interest to athletes. It's possible that this performance-preserving effect is mediated by essential amino acids decreasing muscle inflammation, soreness, and damage.

Frequently asked questions

Does consuming protein before bed help improve muscle building?

In terms of protein timing strategies to maximize muscle protein synthesis (MPS), it is most important to consume enough protein each day and to spread your protein doses throughout the day - about 3 to 4 hours apart. For most people, the hours spent sleeping will be the largest window without a dose of protein to stimulate MPS. Pre-bed protein may help to narrow this window and to further optimize muscle protein synthesis or recovery. Studies have indicated that a 40 gram dose of protein is needed to yield a notable increase in MPS rates during overnight sleep.

Does the type of protein consumed before bed matter?

It is thought that casein (particularly, micellar casein), due to its slow digesting nature, may provide a longer anabolic stimulus during sleep than its fast-digesting counterpart, whey protein. This hypothesis has some conflicting research though. In ERD 32 volume 2 we covered a study that compared whey and casein, which found that muscle and strength adaptations did not differ between groups that underwent a 9-week resistance training program. However, there have not been any head-to-head trials comparing pre-bed whey and casein to determine if one could induce greater MPS over the other. For those interested, ERD 32 volume 2 also covers a study looking at pre-sleep protein.

What should I know?

A 25-gram whey protein supplement timed after an evening training session and again the following morning increased whole body net protein balance over the following 24-hour period in resistance-trained young men. This led to small to moderate improvements in exercise performance 10 and 24 hours post-training. More evidence is needed to see if if and how this effect hold over the longer term. ◆

Increase your gains in understanding by taking in a dose of discussion after reading this article in the ERD Facebook forum!