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The notion that protein makes for stronger muscles is an old belief, but is it accurate? Although some athletes believe the more protein they eat the better, this may not necessarily be true. We asked Dr. Martin Gibala, an internationally recognized expert on protein metabolism, what the most recent science teaches us about protein and its role during and after exercise. In this edition, he talks about how much protein athletes need each day, what types of protein are best and when protein foods should be consumed.

We hope you find this information useful.

Bob Murray

The Role of Protein in Promoting Recovery from Exercise

Martin J. Gibala, Ph.D.

Proper nutrition is essential to help athletes recover from workouts and competitions. It is widely accepted that carbohydrates (CHO) are a critical fuel source during exercise and also play a major role in promoting recovery after exercise. However, the importance of protein is less understood. There is no doubt that protein ingestion helps athletes recover from exercise, but questions remain regarding the optimal amount, type and timing of protein needed in order to optimize training-induced adaptations in skeletal muscle.

How Much Protein do Athletes Need?

The current dietary reference intake (DRI) for protein for persons over 18 years of age, irrespective of physical activity status, is 0.8 grams per kg body weight per day (i.e., 80 g of protein for a 100-kg (220-lb) person). However, many sports nutrition experts have concluded that protein requirements are higher for athletes.[1] The additional protein may be needed in order to promote muscle adaptation during recovery from exercise in several ways:

- Aiding in the repair of exercise-induced damage to muscle fibers.
- Promoting training-induced adaptations in muscle fibers (e.g., synthesis of new proteins that are involved in energy production and/or force generation).
- Facilitating the replenishment of depleted energy stores.

The American College of Sports Medicine (ACSM), American Dietetic Association (ADA) and Dieticians of Canada (DC) recommend that[1]:

- Protein recommendations for endurance athletes are 1.2 to 1.4 g/kg body weight per day, whereas those for resistance and strength-trained athletes may be as high as 1.6 to 1.7 g/kg body weight per day.
- These recommended protein intakes can generally be met through diet alone, without the use of protein or amino acid supplements, if energy intake is adequate to maintain body weight.

Some of the implications of the ACSM/ADA/DC Position Statement[1] are that:

- Individual protein requirements may be influenced by the size of an athlete as well as the demands of his/her sport (i.e., whether the sport is mainly "endurance"- or "strength"-oriented). For example, a 60 kg (132 lb) cross-country runner might require 70-85 grams of protein per day, whereas a 100 kg (220 lb) football player might require up to 160-170 grams of protein daily.
- Athletes require ~10-15% of their daily energy intake from protein, provided that sound nutritional practices are followed and energy intake is sufficient to maintain body weight. If, for example, an athlete consumes 3,000 kcal and 10% of those calories are from protein, that's enough to provide 75 grams of protein (3,000 x 0.10 / 4 kcal per gram of protein).
- Athletes can meet their protein requirements through diet alone, without the aid of protein or amino-acid supplements, as the typical North American diet is rich in protein-containing foods. The exceptions to this recommendation are athletes who are restricting energy intake in order to lose body weight. Under those circumstances, a special effort should be made to consume foods (e.g., meat, fish, eggs) and beverages (e.g., milk) that contain ample amounts of high-quality proteins. Vegetarian athletes should also monitor their food choices carefully.

Recovery from Strength/Resistance Exercise

Heavy resistance exercise increases the rates of both protein synthesis and breakdown in muscle for at least 24 hours after a workout. Unless a protein-containing meal is consumed during recovery, breakdown will exceed synthesis, resulting in the loss of muscle mass. Studies[2,3] have shown:

- The amount of dietary protein needed to stimulate muscle recovery is surprisingly small, only 5-10 g of amino acids (that's only 20-40 kcal of protein).
- Essential amino acids are superior to non-essential amino acids for stimulating muscle growth. Foods such as fish, meat, eggs, and milk are rich in essential amino acids.
- The "maximum effective dose" of amino acids (i.e., the single serving size that will maximally stimulate muscle protein accretion) is not known, however, one study showed that the amount of muscle protein gained was similar when subjects consumed ~20 g or ~40 g of essential amino acids after weightlifting exercise.[4]
- Thus, there seems to be a point of amino acid availability above which no further stimulation of muscle protein synthesis occurs. This suggests that consuming massive single doses of protein in hopes of further accelerating muscle growth (as often practiced by strength athletes) is futile.
- The anabolic boost stimulated by a single dose of amino acids is transient and lasts only one to two hours. This means that ingesting repeated small doses of protein during recovery may be more effective in optimizing the rate of muscle protein gain, as opposed to eating just one large meal.
- Carbohydrate added to a protein mixture does not markedly affect the muscle anabolic response, but does confer other benefits, most important being the resynthesis of muscle glycogen.

Recovery from Endurance Exercise

Muscle glycogen is the predominant fuel for energy during exercise, and the ability to rapidly replenish glycogen stores during recovery is important for athletes. This is particularly true for athletes undergoing long exercise bouts or multiple daily workouts. The best strategy to promote muscle glycogen resynthesis during the initial few hours after exercise is to ingest a high amount of carbohydrate (CHO) at frequent intervals. Provided that CHO is consumed at a rate of about 1.2 grams of CHO per kilogram of body weight per hour (0.5 g/lb/h), in 15 to 30 minute intervals, most evidence suggests that protein added to a recovery drink will not further enhance the rate of muscle glycogen resynthesis.[5]

Protein consumed after exercise does assist in the repair and synthesis of muscle proteins, and as such, is vital to the recovery process. For example, protein added to a CHO/fat supplement increased leg muscle protein accretion during recovery from cycling exercise, as opposed to net

losses in muscle protein when just CHO and fat were ingested.[6]

Does Protein Added to Sports Drink During Exercise Improve Performance?
Two studies recently reported that consuming a protein and CHO beverage during exercise increased performance as compared to CHO alone.[7,8] Both studies measured exercise time to fatigue in trained cyclists using a randomized double-blind repeated measures design. In each experiment, subjects ingested a 7.75% CHO solution on one occasion and a drink that contained 7.75% CHO plus an additional 1.94 % protein (about 4 g of protein per 8-oz serving) on another occasion.

Results
In the first study, subjects cycled at 85% peak VO2max immediately after performing three hours of standardized cycle exercise. Results showed that the subjects:

- Rode 36% longer when ingesting the CHO solution as compared to the placebo.
- Rode 55% longer when ingesting the CHO + protein solution compared to placebo, and this was also significantly longer than the CHO trial.

Although the second study did not include a control group (no placebo trial), the results were similar in that the subjects rode 29% longer during a cycling task at 75% VO2peak when they ingested CHO + protein as compared to CHO alone.

While these results are intriguing, definitive conclusions are hampered by the way the research was conducted. Two major limitations are that:

- Neither study compared the CHO+PRO drink to a CHO beverage that was matched for total energy intake (i.e., the drinks differed in total kcal provided).
- The total amount of CHO provided was less than what is generally recommended to be optimal for endurance performance.

As a result, it is not possible to discern whether the increased time to fatigue was attributable to the influence of protein per se or simply the additional energy provided. It is possible that — like the effect on muscle glycogen resynthesis during recovery — the addition of protein to a CHO beverage is only beneficial when the rate of CHO intake is below the amount needed by the body. Regardless, additional studies will confirm or refute these initial observations and will also evaluate how CHO and protein might (or might not) interact to benefit the athlete during exercise.

Take Home Points

- After a hard workout, athletes should consume a recovery beverage or snack that contains a small amount of high-quality protein with adequate CHO in order to repair/stimulate muscle proteins and also replenish muscle glycogen stores after exercise. Foods such as milk, yogurt, a small sandwich, an energy bar with at least 10 grams of protein or a canned sports nutrition shake are all appropriate choices.
- Although speculative, the muscle proteins stimulated by protein ingestion after endurance exercise are likely related to aerobic energy production (e.g., mitochondrial enzymes), whereas those stimulated after weightlifting exercise are likely related to non-oxidative energy production and force generation (e.g., contractile proteins).
- The “optimal” recovery beverage composition for strength/resistance and endurance athletes remains to be determined. However, any strategy that provides ample CHO and protein will likely be of benefit to both.
- While the addition of protein to a recovery drink is clearly beneficial, it is premature to recommend that protein should be consumed with CHO during exercise.

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