



5

Optimizing training adaptations by manipulating protein

— Kevin Tipton, University of Birmingham, Birmingham, UK

The benefits of protein ingestion associated with exercise have been known for centuries. From Olympians in ancient Greece to modern Olympians in the early 20th century, athletes have consumed large amounts of protein. Protein may influence training adaptations by increasing muscle protein synthesis and providing amino acids for building muscle for increased muscle mass or remodeling of muscle, provision of energy during exercise, providing precursors for making hormones and other compounds important for exercise, mitochondrial biogenesis necessary for increasing muscle oxidative capacity and perhaps for glycogen resynthesis. Many scientists believe that the amount of protein that athletes need to consume is more than sedentary individuals, but the exact amount is highly individual and dependent on many factors. Moreover, the amount of protein ingested is less important than other factors. Recent consensus conferences for the IOC, FIFA and IAAF have concluded that the amount of protein intake is less important than other dietary considerations. For example, the timing of protein intake, especially in relation to bouts of exercise may be vitally important for influencing training adaptations. The type of protein and ingestion of other nutrients alongside protein are also very important. For muscle hypertrophy and increased strength, ingestion of protein in close proximity to exercise seems to be optimal. For adaptations to endurance exercise training, the impact of protein ingestion is less clear. There is some evidence to suggest that ingestion of protein with carbohydrates following exercise may confer some advantages perhaps by influencing glycogen resynthesis. However, this the exact amount, timing and other nutrients to be ingested along with protein remain to be determined.



The myth	The evidence
Large amounts of protein are required to increase muscle mass.	Increased mass and strength are possible on a wide range of protein intakes as long as energy balance is maintained. There is no scientific evidence that excessive (>1.7–2.0 g protein/kg body mass/d) are necessary for gains in muscle mass. Excess protein is oxidized, rather than utilized for muscle building.
Protein requirements for endurance and strength trained athletes have been determined.	There is disagreement among scientists about the requirements for protein intake for athletes. Any requirements are based on the assumption that the benefit of protein intake is linear to the amount ingested. However, the type of protein ingested, timing of protein ingestion and other nutrients ingested with protein will all contribute to the response of muscle.
Recommended protein intakes for athletes should be based on protein requirements for optimal training adaptations.	Protein intake should be individually determined for each athlete based on many factors. For example, training status and type, intensity and duration of training, energy requirements and requirements for other nutrients, as well as other factors such as age, gender and injury status should all be considered.
Whey protein is the best type of protein.	There is insufficient evidence to conclude that any particular type of protein is superior to all others.
Protein supplements are the best way to increase protein intake.	There is no evidence to suggest that protein in supplement form is superior to protein ingested as part of foods. Recent research demonstrates that food protein results in muscle anabolic responses similar to that from protein supplements or free amino acids.

The total amount of protein is the most important consideration for optimal training adaptations.	Given a minimal amount of protein intake, perhaps approximately 1–1.2 g/kg bw/d, other factors associated with protein ingestion, such as timing of protein intake in relation to exercise, type of protein, other nutrients ingested with the protein and the interaction of all these factors are much more important than the total amount ingested.
Many athletes need to increase their protein intake.	Studies show that the vast majority of athletes eat ample protein in their normal diet. Increased protein intake is unnecessary for most. Individual assessments should be made of each diet to determine if more protein is necessary before a concerted effort to increase intake is made.

Strategies for Protein Consumption

When

Protein ingestion in proximity – shortly before and/or within 2 h following – to exercise may provide the optimal conditions to maximize training adaptations, especially for increased muscle mass and strength.

What

There is mounting evidence that the type of protein ingested may influence training adaptations. For example, recent studies indicate that ingestion of animal proteins will result in superior gains in mass and strength over plant sources. Essential amino acids in free form may also offer some advantages, but the impact for athletes is unclear.



How

Protein is found in many food sources, such as meats, fish, egg, dairy, legumes (beans and peas) and other vegetables. There is no evidence to suggest that protein supplements provide superior adaptations over food sources. There is evidence that consumption of protein with carbohydrates and possibly fats may influence adaptations, particularly gains in muscle mass.

How much

Many scientists, coaches and athletes believe that athletes need to ingest more protein than nonactive individuals. However, there is no evidence to support the necessity or even benefit for very high protein intakes, i.e. >1.7–2.0 g protein/kg bw/day. Given the high energy intakes for most athletes, protein intake is likely adequate without supplements or additional effort. Excess protein intake may impair training adaptations if consumed at the expense of other nutrients, particularly carbohydrates that are necessary to support training.

Suggested additional resources

1. Tipton, K.D. and O.C. Witard. Protein requirements and recommendations for athletes: Relevance of ivory tower arguments for practical recommendations. *Clinics in Sports Medicine*. Elsevier. 26 (1), 17-36, 2007.
2. Hawley, J.A., K.D. Tipton and M.L. Millard-Stafford. Promoting training adaptations through nutritional interventions. *J. Sports Sci.* 24:709-721, 2006.
3. Tipton, K.D. and C. P. Sharp. The response of intracellular signaling and muscle protein metabolism to nutrition and exercise. *Eur. J. Sports Sci.* 5, 107-121, 2005.
4. Tipton, K.D. and R.R. Wolfe. Protein and amino acids for athletes. *J. Sports Sci.* 22 (1): 65-79, 2004.