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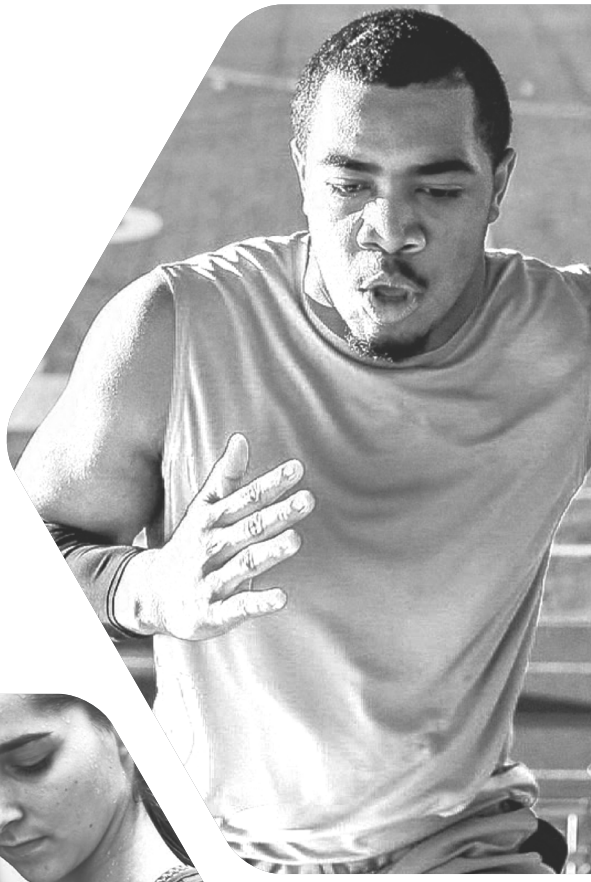
THE SCIENCE OF PROTEIN



THE SCIENCE OF PROTEIN

This document provides an overview of the scientific literature related to the protein needs of athletes, including why and when to eat protein, what type to consume and the appropriate amount.

INTRODUCTION

Proteins are molecules composed of amino acids, the overall structure of which is determined by the chemical interactions between the individual amino acid components. The amino acid profile of a protein also contributes to properties such as digestion rate. After the protein is digested and amino acids absorbed, some amino acids will act as signaling molecules in the body, and some can enter metabolic pathways. However, the primary role of amino acids is to provide the building blocks to create new protein structures in the body. Examples are the contractile proteins in skeletal muscle, enzymes, hormones and transport proteins in the blood.

Each of the protein structures in the body requires a specific set of amino acids. Certain amino acids cannot be made by the body and need to be consumed in the diet; these are referred to as the essential amino acids. Dietary proteins are considered “complete” if all of the essential amino acids are found in the protein source. Examples of complete proteins are dairy foods, meat, fish, poultry and soy. Quinoa is the only grain that is also a complete protein. An incomplete protein is one that lacks adequate amounts of one or more essential amino acid. The majority of plant proteins fall into this category.

The amino acid profile and speed of digestion and absorption are important considerations when choosing dietary protein sources to meet the sports nutrition needs of athletes.

DAILY PROTEIN INTAKE

The recommended dietary allowance (RDA) for protein intake for healthy adults is 0.8 g/kg/day. Athletes need higher amounts of protein in their diet to support adaptation and repair in response to their training demands.[14] Recommended intake for an athlete is dictated by their training program and goals, in the range of 1.2-2.0 g/kg/day.[10,14] These recommendations should be met by eating high-quality protein sources spread evenly throughout the day, with adequate total calories (especially carbohydrate) to promote the use of the amino acids for MPS as opposed to oxidation for energy.[2,5,8,18]

THE ROLE OF PROTEIN FOR SPORTS NUTRITION

Protein Before and During Training

The potential benefit to consuming protein before or during exercise depends on the goal of the athlete. If an athlete is looking to promote muscle protein synthesis and gain lean mass as a result of strength training, a small amount of protein before and during a training session may be beneficial.[21] The actual amount of protein to consume during this time has not been defined. It would be practical for the athlete to choose a source of protein that is easily digested in an amount that does not cause an upset stomach.

If the athlete's goal is to improve endurance performance, the research in this area has yielded mixed results. At this time, there is not a clear benefit to consuming protein before or during endurance training or racing.[21] Research has not been conducted to determine if protein intake before or during exercise can help improve the performance of team sport athletes.

For more information on this topic, please see Sports Science Exchange #109 "Is There a Need for Protein Ingestion During Exercise?" by Dr. Luc van Loon, found at www.gssiweb.org.[21]

Protein After Training for Recovery

Protein structures in the body are constantly turning over, breaking down and rebuilding with new amino acids from the diet. Referring specifically to protein structures in the muscle, the terms Muscle Protein Synthesis (MPS) and Muscle Protein Breakdown (MPB) describe the ongoing process of breaking down existing structures and building new structures. Exercise will result in an increase in MPB; however, the more significant impact of exercise on the muscle is to increase MPS.[13] The type of exercise determines which protein fraction of the muscle will be impacted. For example, resistance exercise results in increased MPS for the contractile proteins of the muscle, while MPS of the mitochondrial proteins is stimulated with endurance exercise. Regardless, protein consumption following training is necessary to fully take advantage of this benefit.[13] While this process of building new proteins begins quickly, the benefit will only become apparent after a period of time when enough new proteins have been created. Therefore, regular protein consumption following training is a good habit for athletes to adopt.

MORE IS NOT BETTER

Eating more than about 20 g, or 0.25-0.3 g/kg, of protein at one time does not result in creating more muscle. The extra amino acids are oxidized or burned as fuel.[18,23] To gain muscle a better practice is to eat about 20 g of protein about every 3 hours throughout the day.[2,8] However, when doing intense, total body exercise, closer to 40 g could be appropriate.[6]

SUMMARY OF RECOVERY PROTEIN CONSIDERATIONS

Timing: As soon as possible after exercise

Type: Most complete protein sources are adequate, however the best sources are whey or milk proteins

Amount: ~20 g, or 0.25-0.30 g/kg

Timing: Despite popular theories, an exact window of time in which protein should be consumed following a training session has not been determined. Therefore, athletes should eat shortly after finishing a workout or competition, as soon as their stomach will tolerate food.[12,18] Choosing a liquid form of protein over a solid may help athletes consume their recovery nutrients shortly following exercise.

Recovery continues after the immediate post-exercise period, and athletes should strive to maintain a positive net protein balance throughout the day. This can be achieved by ingesting protein in a regular pattern throughout the day, every 3-4 hours,[2,5,8,18] beginning with the initial recovery snack.[2,8] Additionally, consuming ~30 g casein protein prior to sleep may also promote recovery via increased muscle protein synthesis. This benefit may be enhanced when performing exercise training in the evening.[5,19,20]

Amount: Two dose-response studies, one using egg protein[7] and the other whey,[23] have shown that 20 g of protein consumed following resistance exercise achieved maximal rates of MPS, with no further benefit achieved at 40 g.[7,23] However, both of these studies utilized a leg-only exercise protocol. In a study using a whole-body resistance exercise protocol, 40 g of whey protein resulted in significantly greater MPS than 20 g, with no difference found when the subjects were segmented for lean body mass.[6] Based on current research, it appears most athletes should aim for 20-40 g of protein for recovery following training. To calculate individual protein needs, the suggestion is 0.25-0.30 g/kg body weight.[18,23]

Type: A recovery meal or product should contain a complete protein that is quickly digested and absorbed and rich in the amino acid leucine. A greater and quicker rise of leucine in the blood triggers a greater increase in MPS.[1,18]

Whey and soy proteins are both digested at a faster rate than casein.[11] However, whey and casein both have a higher leucine content than soy.[11,17] While soy is a good choice as a protein source throughout the day, research clearly shows whey and milk protein (a blend of whey and casein) are superior to soy in promoting post-exercise muscle protein synthesis[11,22] and result in greater muscle hypertrophy with training.[4]

For vegetarian and vegan athletes, soy is an appropriate choice for recovery, and provides all the essential amino acids. Research is emerging on the use of plant-based proteins for recovery and muscle gain.[15,16] In several studies, the use of 30 g of protein derived from plant based sources (potato or a blend), resulted in similar increases in muscle protein synthesis compared to milk protein.[15,16] Athletes consuming plant-based proteins should ensure they are eating a variety of foods in order to meet their essential amino acid needs to support recovery and training adaptations.[15] It is important to note that plant-based protein, in its natural form, has lower digestibility than animal-based protein. Processing or cooking, such as heating, soaking or boiling improves the digestibility of plant-based proteins.[3] Athletes following a plant-based diet have the potential to stimulate muscle protein synthesis throughout the day as they combine food groups, increase overall portion sizes, and optimize amino acid availability through processing or cooking.[9]

Any opinions or scientific interpretations expressed in this document are those of the author and do not necessarily reflect the position or policy of PepsiCo, Inc.

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