

The BASES Expert Statement on protein recommendations for athletes: amount, type and timing

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Introduction

The topic of protein nutrition is continually evolving, with much interest focussed on recommendations for athletes. From an applied perspective, each of the 4000+ meals consumed across an Olympic cycle (assuming 3 meals/day) provides an opportunity for dietary protein to support recovery, adaptation and/or athletic performance. This expert statement presents concise, evidence-based, and practically relevant protein recommendations for athletes.

Background

The primary nutritional role of dietary protein is the provision of amino acids (AA) for the synthesis of new, functional proteins, including skeletal muscle (termed muscle protein synthesis [MPS]). While sufficient non-essential amino acids can be supplied endogenously, an exogenous (e.g., dietary) supply of essential amino acids (EAA) is necessary for the stimulation of MPS, perhaps highlighting the importance of specific AA above protein requirements. Muscle proteins are constantly turning over ($\sim 1\text{--}2\% \cdot \text{day}^{-1}$), with the degradation of old, damaged proteins and synthesis of new, functional proteins. Hence, refining protein recommendations beyond simply total daily intakes to encompass the nuances of each postprandial MPS response, is warranted.

Dietary protein recommendations

It is generally accepted that recommended protein intakes for athletes ($\geq 1.6 \text{g} \cdot \text{kg}^{-1} \cdot \text{day}^{-1}$) should exceed the current UK Recommended Daily Allowance (RDA) of $\sim 0.8 \text{g} \cdot \text{kg} \cdot \text{BW}^{-1} \cdot \text{day}^{-1}$. Whilst these guidelines are ≥ 2 -fold the RDA, there is currently no evidence that high(er) protein diets are harmful to health (e.g., kidney/bone) in otherwise healthy individuals. Our growing understanding of acute MPS responses to single meal/exercise bouts in healthy young adults has begun to refine these recommendations to a per meal approach. Close to a consensus has been reached that a per meal dose of $\sim 20\text{--}30 \text{g}$ ($\sim 0.25\text{--}0.30 \text{g} \cdot \text{kg} \cdot \text{BW}^{-1}$) of high-quality protein (equating to $\sim 3 \text{g}$ leucine; $8\text{--}10 \text{g}$ EAA) for an $\sim 80 \text{kg}$ individual is sufficient for the maximal (but transient; around 2–5h) stimulation of MPS (Witard *et al.*, 2014). However, the AA composition, specifically EAA profile and leucine content (the intracellular appearance of which seems particularly important for the stimulation of MPS) of the protein source will ultimately influence the required protein dose for maximal stimulation of MPS. The metabolic fate of ingested protein beyond this threshold is primarily directed towards oxidative processes rather than incorporation into new muscle proteins. As a logical extension, the notion that daily protein intake should be spread evenly between meals/servings ($\sim 3\text{--}4 \text{h}$), whilst considering exercise training times, is intuitive. However, whilst data are encouraging, clear confirmatory data of this concept remained to be reported. Protein ingestion in close temporal proximity to exercise completion may augment, and certainly will not impair, the MPS response and subsequent muscle adaptation. However, the MPS machinery remains sensitive to (each and every) protein feeding for at least 24h post-exercise, meaning that protein nutrition remains an important consideration beyond the initial 1–2h post-exercise ‘anabolic-window’ (Wall *et al.*, 2016). Protein ingestion prior to and/or during exercise also stimulates MPS,

albeit with these approaches potentially more favourably directed towards oxidation to serve as a metabolic fuel. Further, it may also be advisable to avoid protein prior to exercise to reduce the risk of developing GI symptoms. It is also suggested that consumption of protein is beneficial for remodelling when consumed prior to sleep, supporting a positive net protein balance during the overnight period (Trommelen *et al.*, 2016).

How can dietary protein intake be tailored for the individual athlete?

The provision of bespoke recommendations is a contemporary topic in sports nutrition. Based on data generated from a series of recent controlled laboratory-studies, we are beginning to refine our understanding of what an optimal protein dose may look like for different athletes (e.g., age, sex, athletic discipline, physical impairment etc.) with different training goals. With whole-body exercise (e.g., swimming), the maximal effective dose of protein for stimulation of MPS may be greater than with limb-specific exercise (e.g., cycling), although current data are equivocal (Macnaughton *et al.*, 2016). While limited evidence exists to inform protein recommendations for athletes with physical impairments, factors such as the total functional body mass and digestion and absorption kinetics should be considered in these populations. Further, though the dose required for maximal stimulation of MPS remains unknown, the age of the athlete may also be an important consideration, particularly as the minimal effective dose for stimulating MPS appears to be higher with advancing age (Moore *et al.*, 2015). In contrast, the absence of any sex-specific differences in MPS with protein ingestion suggests that the dietary protein recommendations would not differ between male and female athletes. Finally, additional considerations for protein consumption may be required during the off-season, periods of detraining and/or injury when physical activity levels are dramatically reduced.

Where should athletes get their protein from?

The research base from which the aforementioned recommendations are generated comes primarily from studies that have administered rapidly digestible, leucine-rich, isolated, animal-derived proteins. A recent emphasis has widened the focus to investigate the anabolic potency of whole-foods and plant-based proteins. Whole-foods are typically nutrient-dense and better represent habitual dietary patterns than isolated protein sources. Unlike isolated sources, protein-rich whole-foods contain other non-protein derived nutrients that theoretically may affect the stimulation of MPS, although this area of research is in its infancy. Nevertheless, the preponderance of data suggests that protein-rich whole-foods (e.g., egg, beef, salmon, whole-milk) do not inhibit the MPS response (Burd *et al.*, 2019) and, combined with the pragmatism of having to account for ‘other’ nutritional needs, we recommend that the majority of an athletes’ protein intake should be derived from whole-food sources, where possible. Plant protein sources (e.g., soy, wheat) offer a means to reduce intake of animal-sourced foods and diversify an athlete’s diet. Limited data (in terms of sources investigated) to date suggest plant proteins are less potent in stimulating MPS compared with animal proteins, which is assumed to be attributable to the typical lower EAA content and/or lower protein digestibility, though appears to be overcome

by increasing the dose (van Vliet *et al.*, 2015). Accordingly, when protein intake is suboptimal, particular attention to protein quality and/or the application of plant protein blends with complementary EAA profiles may be an effective strategy to compensate. As a note of caution, the application of this practice may be challenging for some athletes given the potential excess energy intake and increased potential for GI issues (e.g., fibre intake) from very high-dose plant protein ingestion. Nevertheless, based on current evidence, if sufficient daily protein is consumed ($> 1.6\text{g}\cdot\text{kgBW}^{-1}\cdot\text{day}^{-1}$), the impact of protein source on muscle adaptation is likely negligible (Morgan *et al.*, 2021).

What are the protein recommendations for optimising body composition?

Fat loss is a common goal amongst athletes and can be achieved by progressively restricting energy intake and/or increasing training load/intensity to create an energy deficit. However, this body mass loss often results in the undesirable loss of both fat and lean mass. Strategies that increase daily protein intake beyond normal recommendations ($1.6\text{--}2.4\text{g}\cdot\text{kgBW}^{-1}\cdot\text{day}^{-1}$) have been effective in retaining (more) lean mass during energy deficit (Longland *et al.*, 2016). Indeed, the consumption of a high-protein diet with intense exercise has been shown to lead to a simultaneous gain in muscle and loss of fat mass (Mettler *et al.*, 2010). However, if the energy deficit is sufficiently large ($> 30\%$), then dietary protein may have limited potential to mitigate lean mass loss. Some athletes may also wish to use protein as a way of leveraging a sustainable low-calorie diet given the satiating and thermogenic effects of protein over carbohydrate or fat. However, an additional concern with high-protein diets is the trade-off with other nutrients, particularly if carbohydrate is limiting for performance.



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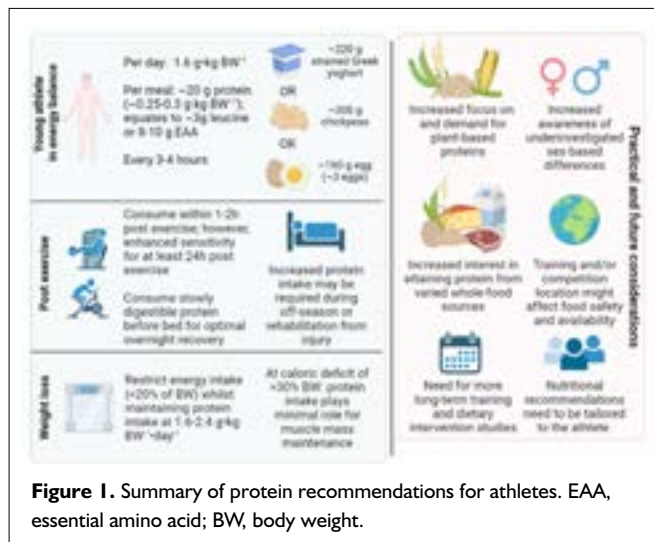


Figure 1. Summary of protein recommendations for athletes. EAA, essential amino acid; BW, body weight.

Conclusions

Numerous scientific and practical nuances warrant consideration when devising protein recommendations for athletes. A summary of our conclusions and future research suggestions is illustrated in Figure 1. ■

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This expert statement is dedicated to the late Professor Kevin Tipton who made a significant contribution to the field of protein nutrition and muscle hypertrophy.

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