Protein: An Ergogenic Aid

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Abstract

Background: Protein consumption increases physical performance by inducing muscle hypertrophy through the stimulation of muscle protein synthesis (MPS). MPS response is heightened synergistically by resistance exercise and protein ingestion, however the exact timeline of optimal ingestion patterns is still unclear, and may be dependent upon the quality and quantity of protein, or individual age and gender. **Objective:** The objective of this research was to determine the optimal timing and distribution of protein ingestion to increase MPS and enhance performance, taking into consideration protein source, age and gender. **Methods:** A comprehensive literature review using Google Scholar, PubMed, Medline (Ovid), and Scholars Portal. **Results:** When considering quality of protein, one must consider the rate of digestion and its leucine content for its ability to stimulate MPS through mammalian target of rapamycin (mTOR) signalling pathway. However, there are many sources of protein to choose from, one of the more recent being of vegetable form. The current RDA is 0.8 g/kg bw/day; however, this represents the needs of sedentary individuals. In the young, 20 g of protein optimizes MPS immediately following lower body resistance exercise (RE), yet 40 g optimally stimulates MPS following whole body RE. Similarly, the elderly display a greater MPS response with a 40 g ingestion following RE, and they are still able to produce sufficient MPS despite age related muscle loss (sarcopenia) providing they consume adequate amounts of essential amino acids (EAA, 7 - 10 g per meal). Likewise, there is no significant difference in females' ability to induce an MPS response despite significant hormone differences. **Conclusion:** Fast digesting proteins (20 – 40 g) containing high amounts of leucine stimulate MPS optimally in the young and elderly, and men and women. The exact timing and distribution of protein require further research.

Introduction

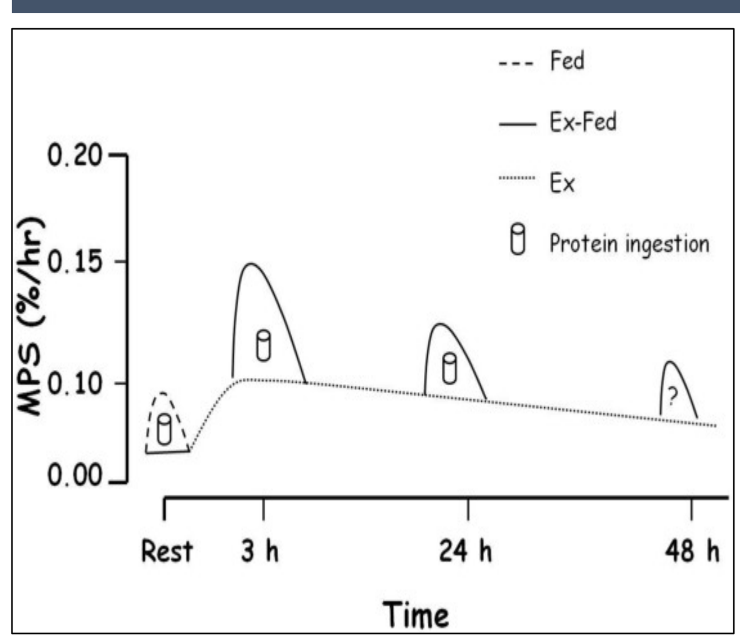

Figure 1. "Anabolic Window". Protein ingestion maximally elevates muscle protein synthesis (MPS) immediately post resistance exercise (RE). This response wanes over time, but may still be present up to 48h later *(Churchward-Venne et al, 2012).*

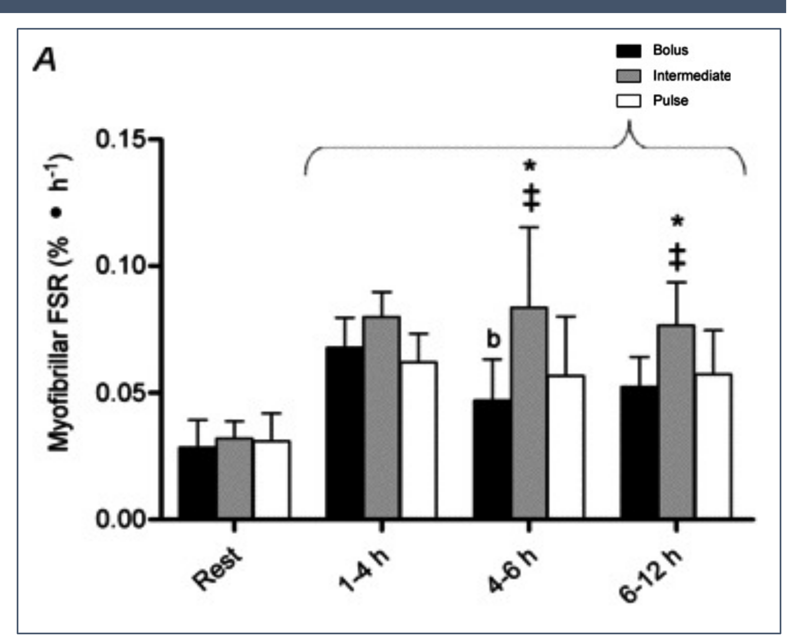

Figure 2. Protein Distribution and Myofibrillar FSR. When matched for total whey protein ingestion (80 g) over 12 h, Int (20 g every 3 h) increases myofibrillar FSR post RE to a greater extent then Bolus (40 g every 6 h) and Pulse (10 g every 1.5 h) *(Areta et al, 2013).*

Objective and Methods

Objective: The objective of this research was to determine the optimal timing and distribution of protein ingestion to increase muscle protein synthesis (MPS) and enhance performance, taking into consideration protein source, age and gender.

Methods: A comprehensive literature review utilizing Google Scholar, PubMed, Medline (Ovid), and Scholars Portal using the terms that include both "resistance exercise" and/or one or a combination of the following "protein, whey, casein, soy, plant protein, elderly, females".

Fractional Synthetic Rate (FSR): is a proxy measure of muscle protein synthesis (MPS)

Type of Protein

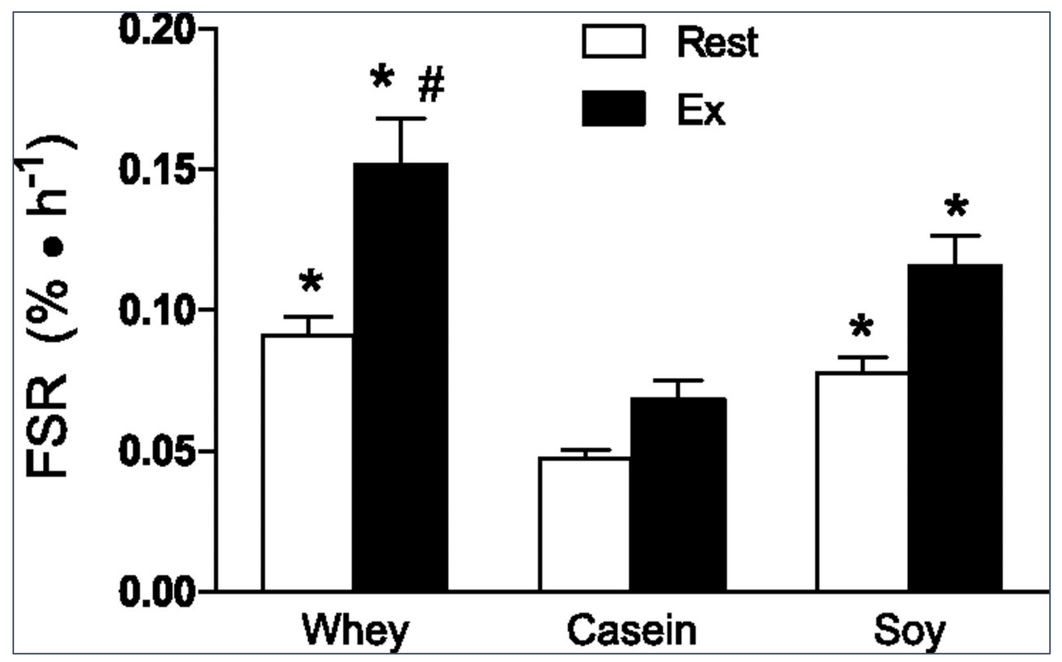

Figure 3. Protein Source and Muscle Protein FSR. When matched for EAA content (10 g), whey stimulates Muscle Protein FSR to a greater degree than soy and casein in healthy young (22 ± 4 y) men at rest and after resistance exercise. Whey and soy are fast digesting protein, whereas casein is a slow digesting protein *(Tang et al, 2009).*

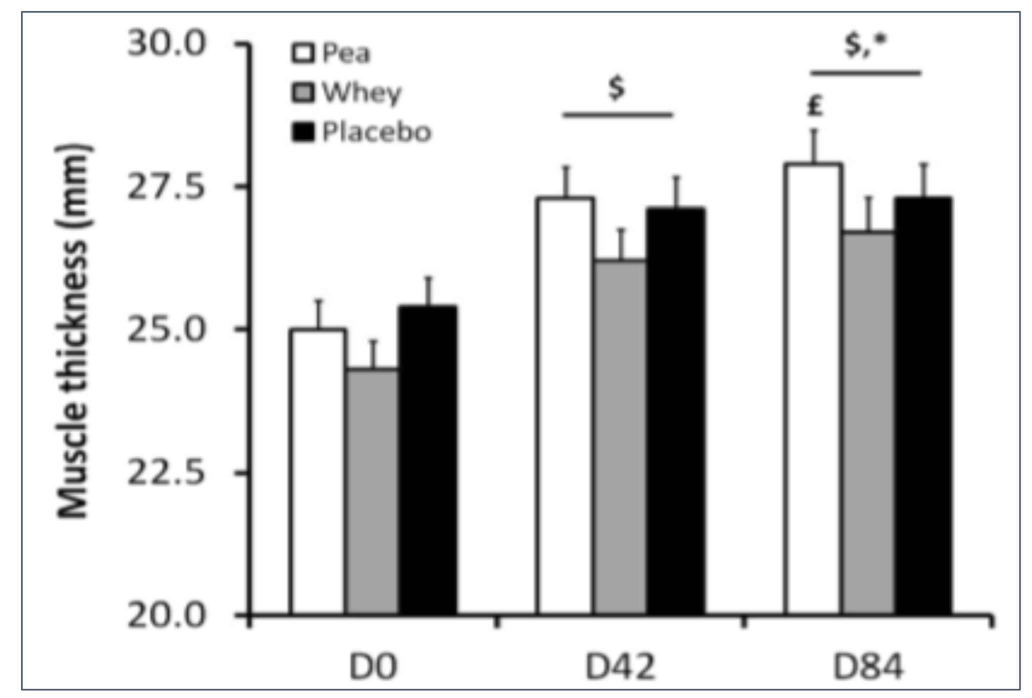

Figure 4. Pea Protein and Muscle Thickness. Pea and whey protein (25 g) supplementation similarly increase bicep brachii muscle thickness to a greater extent than placebo during a 12 week RE in young men (18 - 35 y) *(Babault et al, 2015).*

Amount of Protein

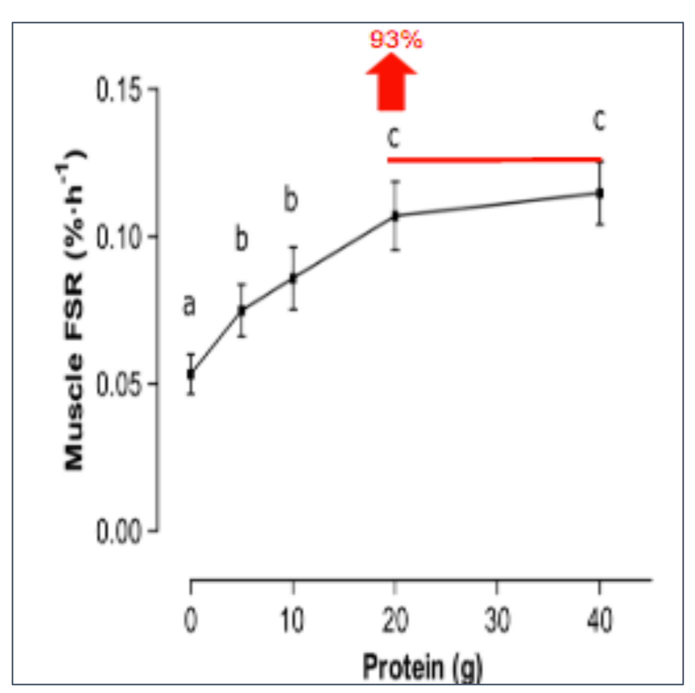

Figure 5. Protein Dosage and Muscle Protein FSR in Young Lower Body RE Men. Egg protein increases muscle protein FSR in a dose dependent manner up to 20 g intake following lower-body RE in young trained healthy men (22 ± 2 y) *(Moore et al, 2009).*

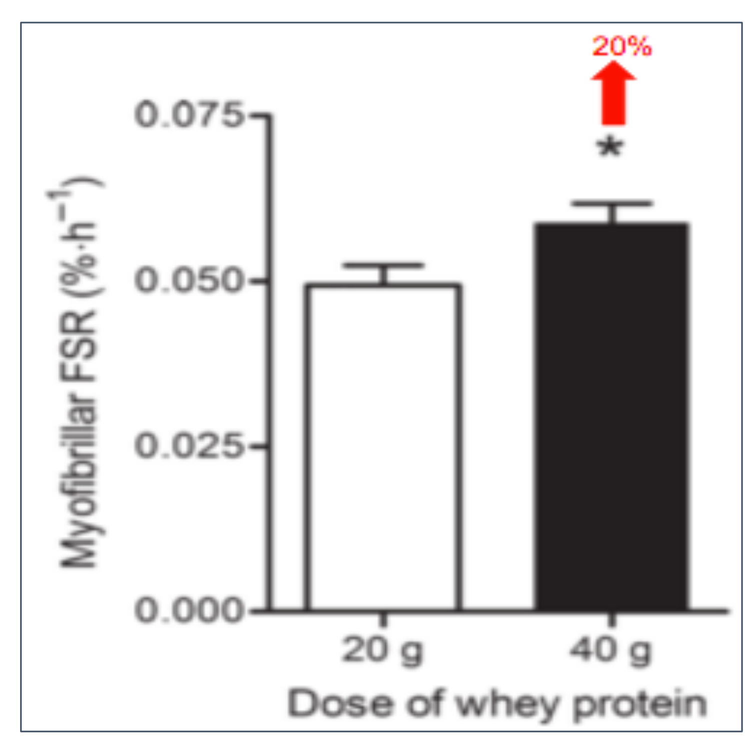

Figure 6. Protein Dosage and Myofibrillar FSR in Young Whole Body RE Men. A 40 g dose of whey protein stimulates myofibrillar FSR to a greater extent than a 20 g dose following a bout of whole-body RE in young trained men (21 ± 4 y) *(Macnaughton et al, 2016).*

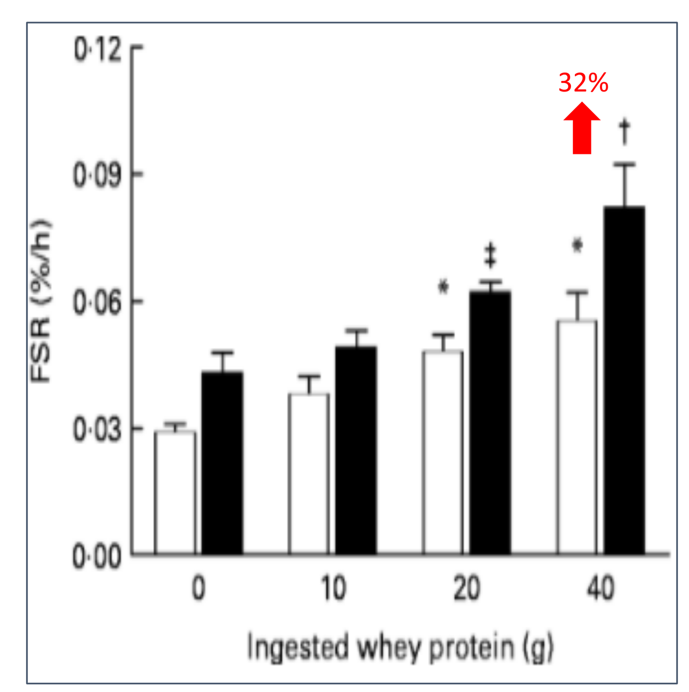

Figure 7: Protein Dosage and myofibrillar FSR in the Elderly. A 40 g dose of whey protein optimally stimulates myofibrillar FSR in the elderly (71 ± 4 y) following unilateral leg-based RE. (□) Non exercised leg, (■) exercised leg *(Yang et al, 2012).*

Age and Gender

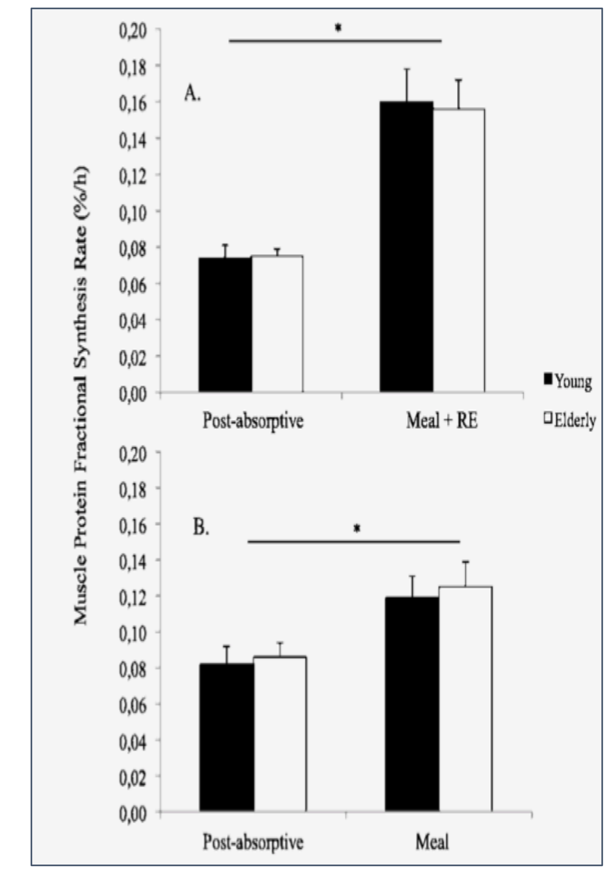

Figure 8. Influence of Age on Muscle Protein FSR. Muscle protein FSR is similarly stimulated in both young (29 ± 3 y) and elderly men (67 ± 2 y) A) after a protein rich meal (90 g) & knee extension, and B) following ingestion of a protein rich meal alone *(Symons et al, 2011).*

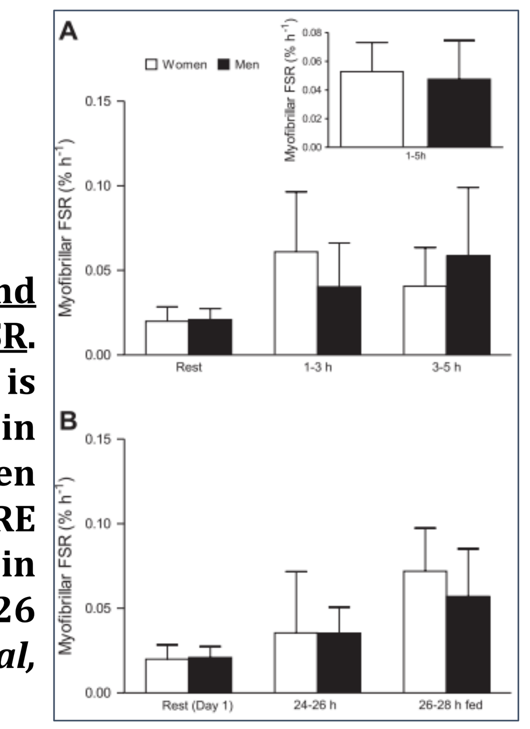

Figure 9: Gender and Myofibrillar FSR. Myofibrillar FSR is similarly stimulated in both men and women (20 ± 4 y) following RE and whey protein intake (25 g, 0 h and 26 h post RE) *(West et al, 2012).*

Result Highlights

- Protein intake in close proximity to exercise optimizes muscle protein synthesis (MPS)
- Protein intake ≥ 20 g stimulates optimal MPS
- Elderly need 20 g at rest and 40 g after resistance exercise to optimally stimulate MPS
- MPS in females responds similarly to that in males at rest and after exercise

Discussion and Implications

Future research is required in this field to delineate the following:

- Effectiveness of protein blends, and plant based sources
- MPS response in women, the middle aged and the elderly population
- Immune system response to specific proteins and their impact on exercise and sport performance
- Influence of macronutrient co-ingestion on MPS
- Protein demands due to exercise training intensity, volume and type

References

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2. Areta et al, J Physiol 2013
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5. Moore et al, Am J Clin Nutr 2009
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8. Symons et al, J Nutr Health Aging 2011
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