PROTEIN FROM DAIRY, MEAT, FISH, AND PLANTS: WHAT'S THE DIFFERENCE FOR MUSCLE RECOVERY IN ATHLETES?

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Recovery is a crucial, but complex, concept for athlete health and performance

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Rehydrate

Refuel

Repair

Remodel

Injury management

Immune surveillance

Sleep quality

What will be covered during this Dairy Council talk?

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1. Highlight the importance of muscle protein synthesis in the muscle remodelling process during exercise recovery

2. Establish 3 key factors that dictate the muscle remodeling properties of a a given protein source, including dairy proteins

3. Compare the capacity of dairy vs. meat or plant-based protein sources to promote muscle remodeling during recovery in athletes

4. Dairy nutrition and global food sustainability

5. Future directions in dairy nutrition and athlete recovery

What is muscle protein synthesis and why should the athlete care?

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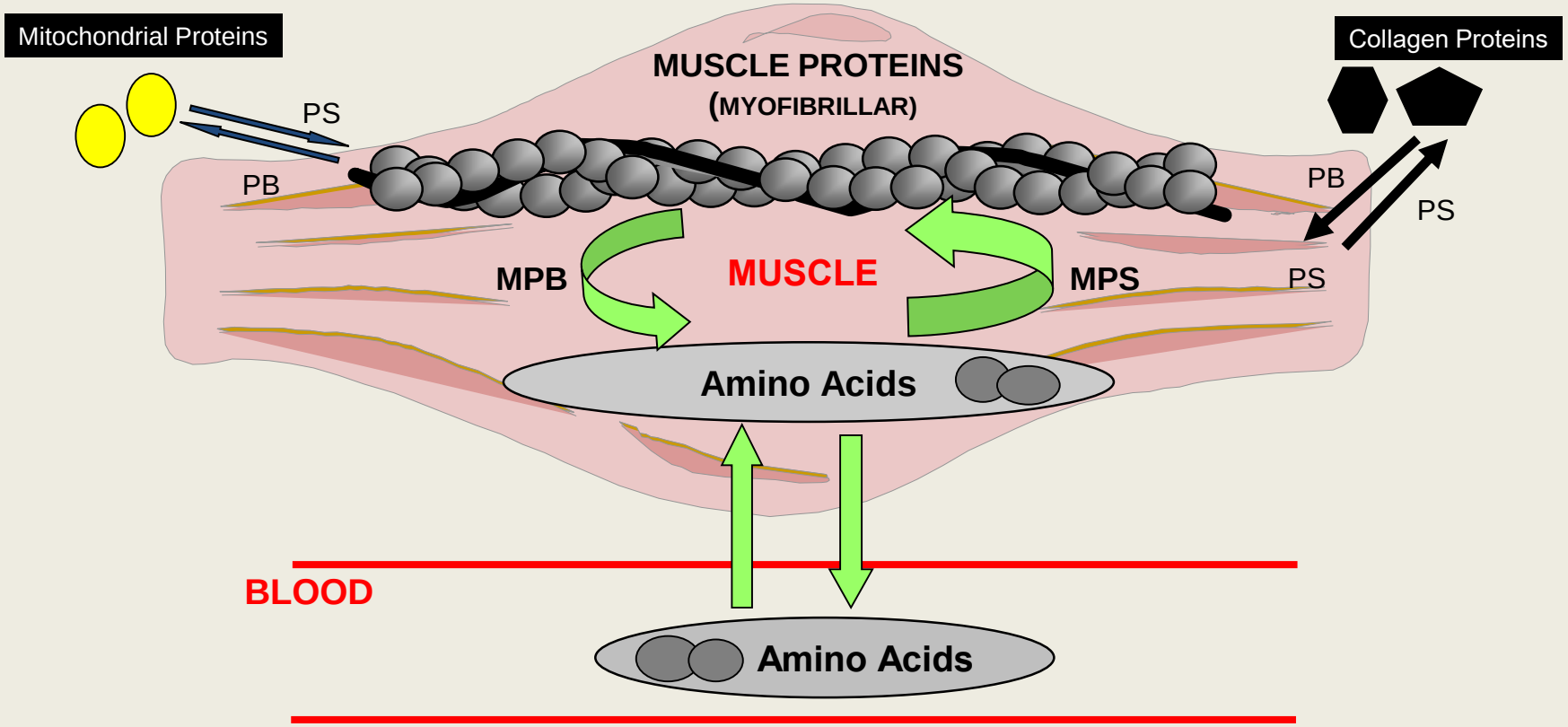

Optimising protein nutrition for muscle remodeling is more complex than simply recommending a daily total protein intake

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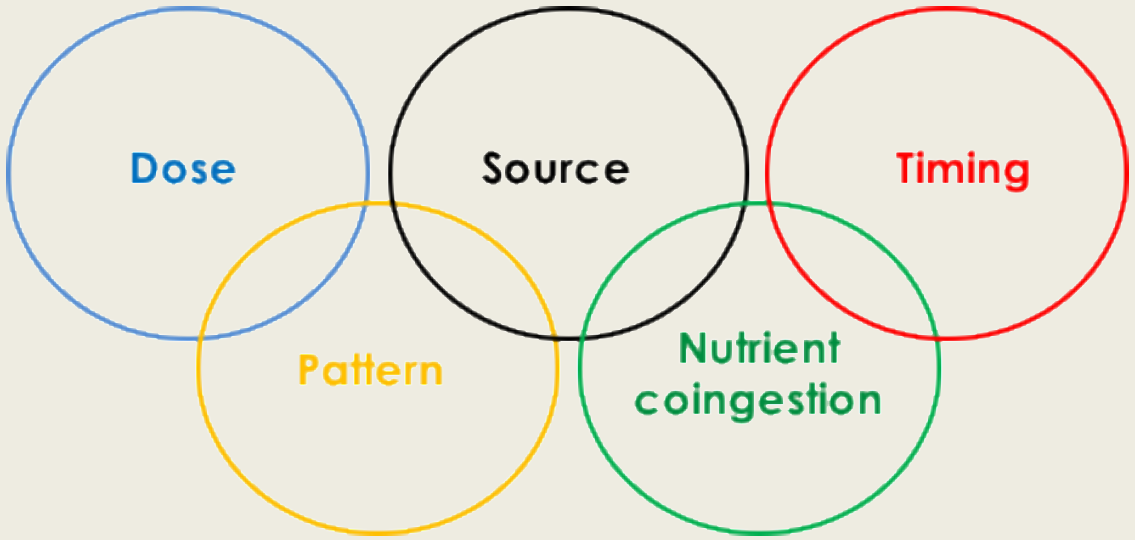

Witard et al • 2016 • Nutrients • 23: 181-185.

A relative protein dose of ~0.3 g/ kg BM is sufficient to maximally stimulate MPS in trained young adults

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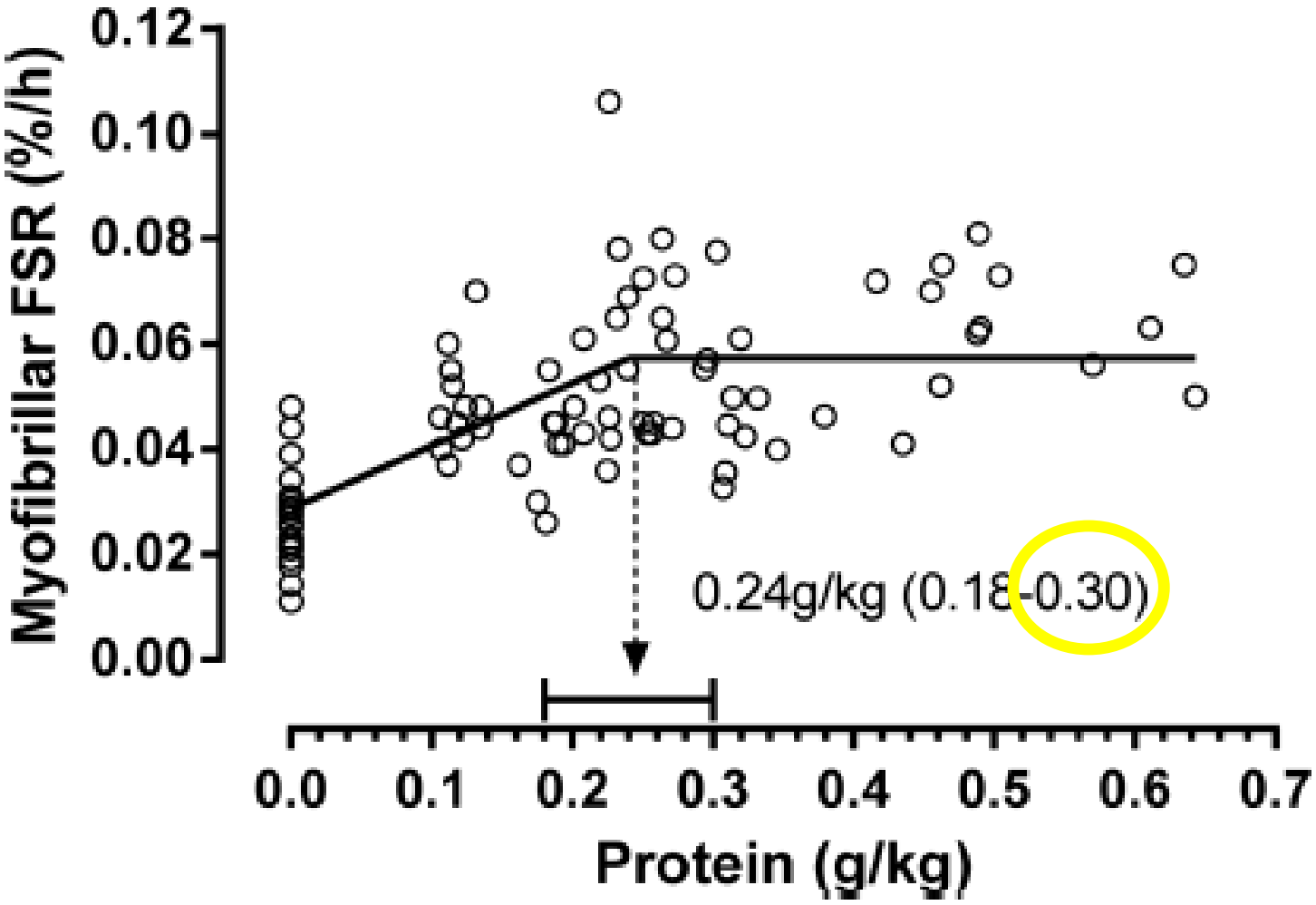
Dose



Moore, Churchward-Venne, Witard et al • 2015 • J Gerontology

So, what does a serving size of 0.3 grams of protein per kilogram body mass look like for different sized athletes?

Striker (female) (60 kg)

Midfielder (70 kg)

Defender (85kg)

Example protein foods for the 85 kg athlete

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Raw salmon
1 medium fillet (150g) = 31 g protein

Lean beef steak
1 medium fillet (150 g-raw) = 35 g protein

Pork tenderloin
2 thin slices (150 g)
= 31 g protein

Canned in water tuna (drained)
1 can (130 g)
= 31 g protein

Cooked beans (Lentils/chickpeas)
2 cups (360 g) = 26 g protein

Large eggs
3 pieces = 25 g protein

What does ~30 g of protein look like?

Emmental cheese
5 slices (110 g)
= 33 g protein

Whey Protein
1 average serving (1 scoop (30 g))
= 27 g protein

Cooked chicken breast
1 small fillet (100 g)
= 31 g protein

Greek yogurt 0% fat or cottage cheese
1 cup (250 g)
= 26 g protein

Low Fat Chocolate Milk
750 mL = 26 g protein

Peanut butter
7 heaped teaspoons (98 g)
= 26 g protein

What 3 factors determine the potential of a protein source, including dairy, to stimulate MPS?

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Source

Source A		Source B
☐	*Protein digestibility*	☐
☐	*EAA profile*	☐
☐	*Leucine content*	☐

Brick wall analogy:
EAA profile and leucine content of protein source

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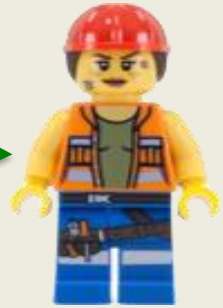
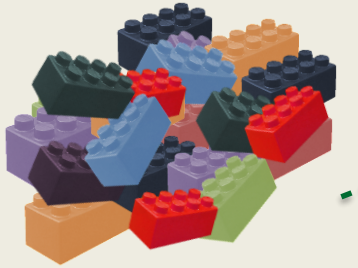
Leucine
Isoleucine
Valine
Phenylalanine
Threonine
Tryptophan
Histidine
Methionine
Lysine



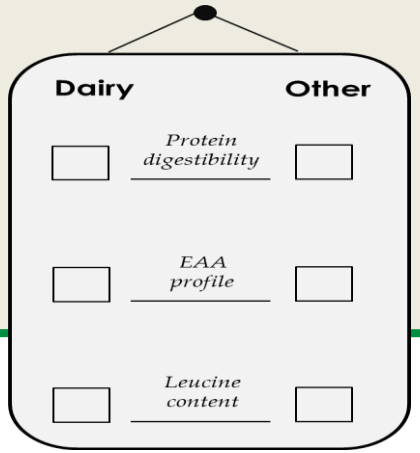
↑mTORC1 PATHWAY

+



Endogenous amino acid pool (NEAA+EAA)

Muscle protein



Total ileal protein digestibility of dairy vs. other common animal and plant-based dietary protein sources

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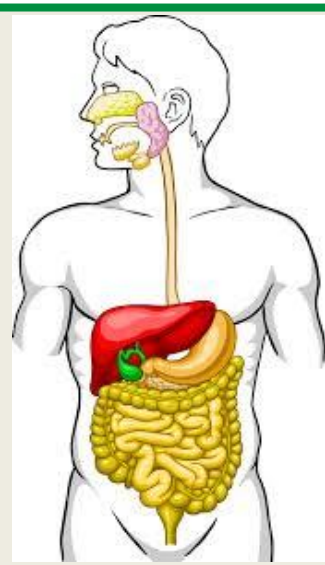

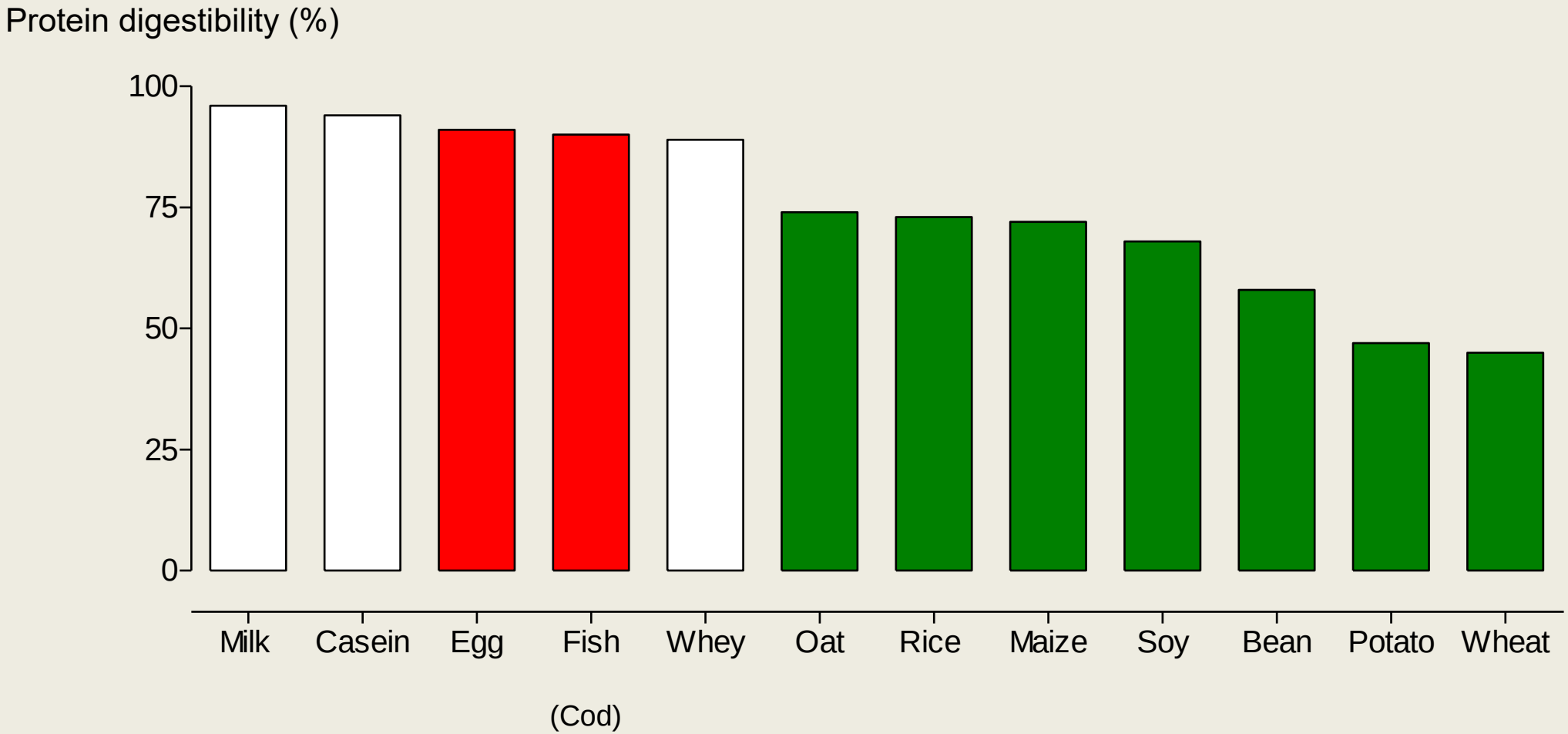

Data taken from 2011 FAO consultation on
"Protein quality evaluation in human nutrition"

EAA profile and leucine content of dairy vs. other common animal and plant-based dietary protein sources

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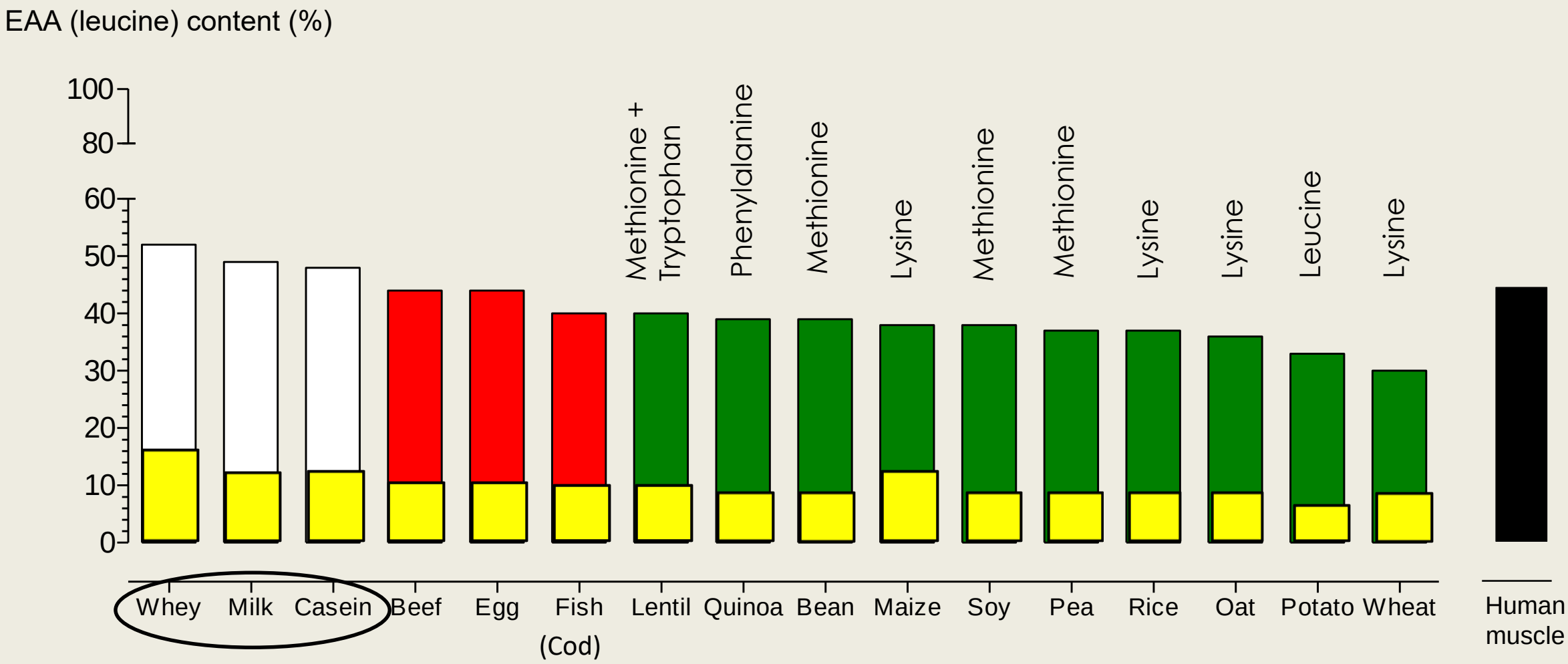

Adapted from **van Vliet** et al 2015 J Nutr

Protein from dairy vs. plant-based protein sources:

What's the difference for muscle remodelling during exercise recovery?

Milk ingestion after exercise promotes greater muscle anabolism compared with soy in trained young men

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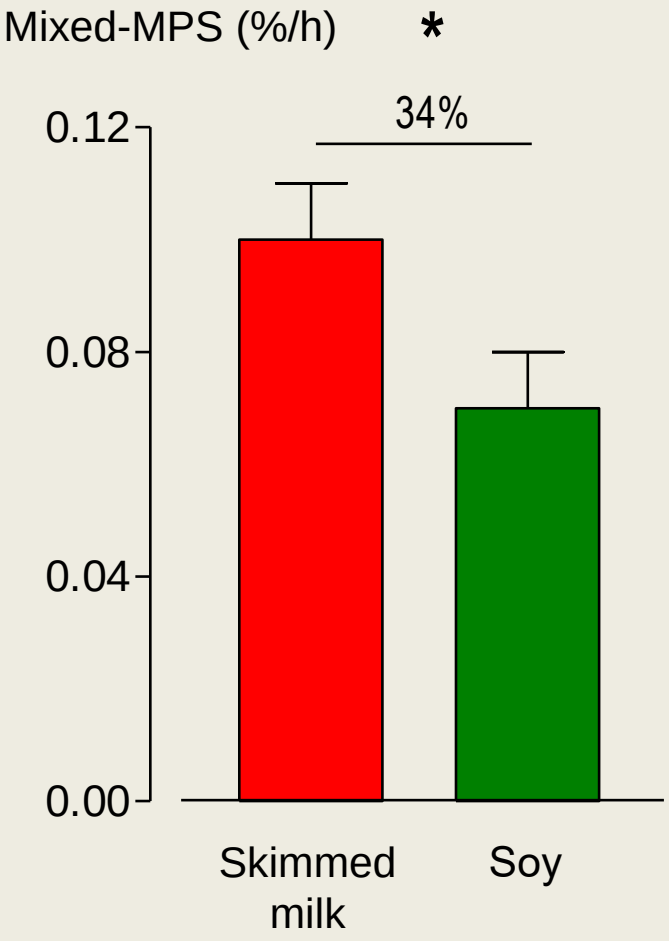

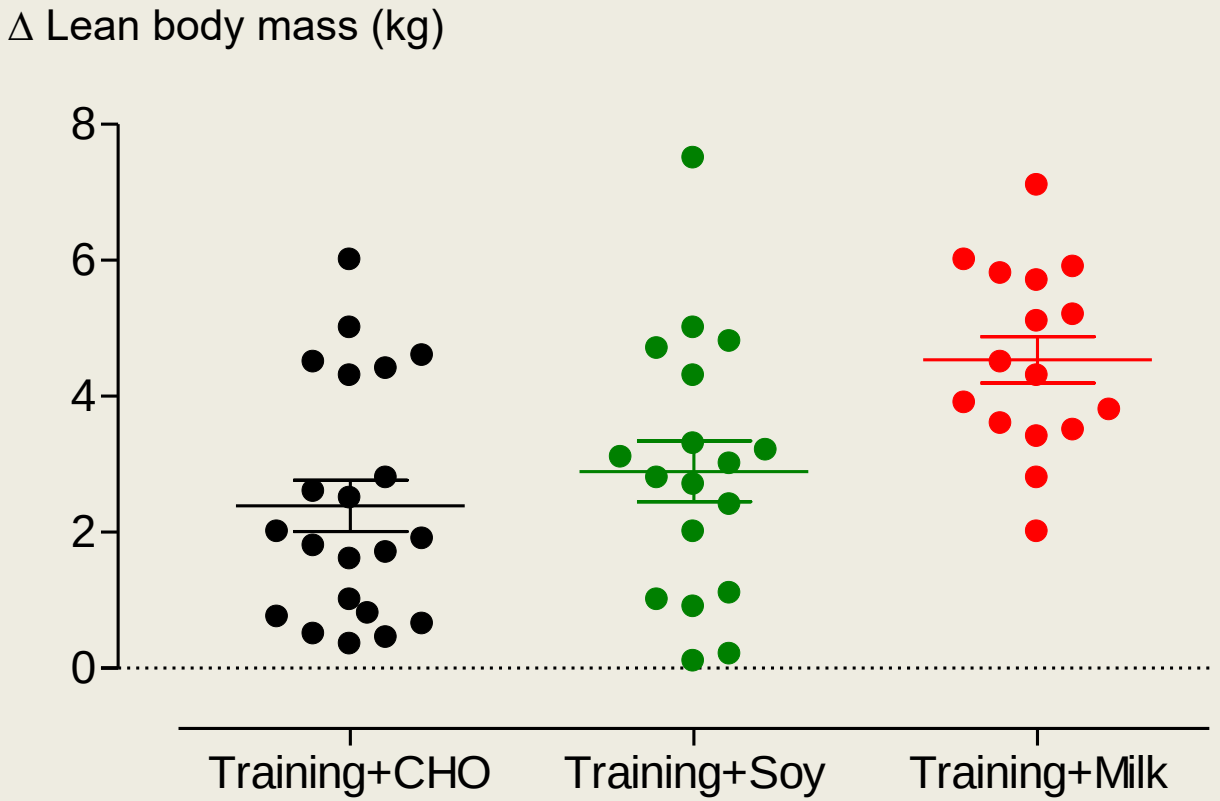

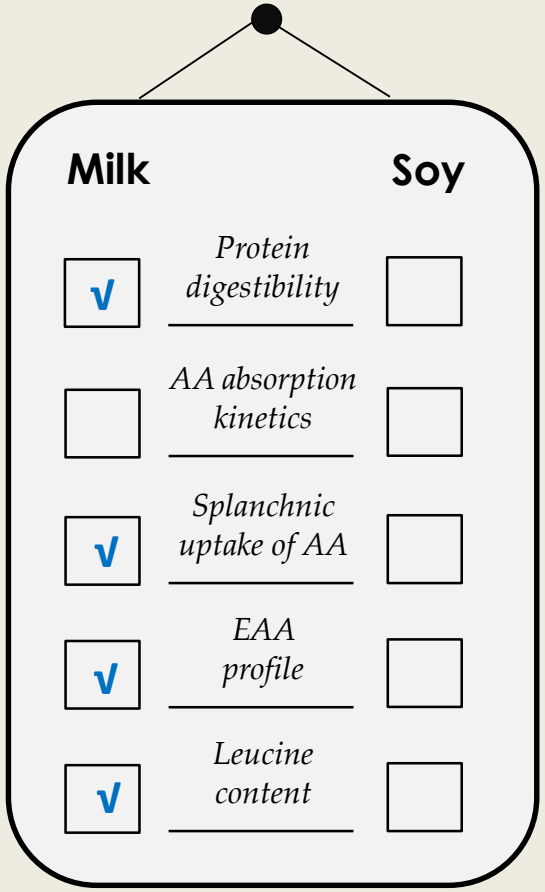

Wilkinson *et al.* (2007), Am J Clin Nutr

Hartman *et al.* (2007), Am J Clin Nutr

The whey component of milk is primarily responsible for the greater response of MPS to milk ingestion vs. soy protein

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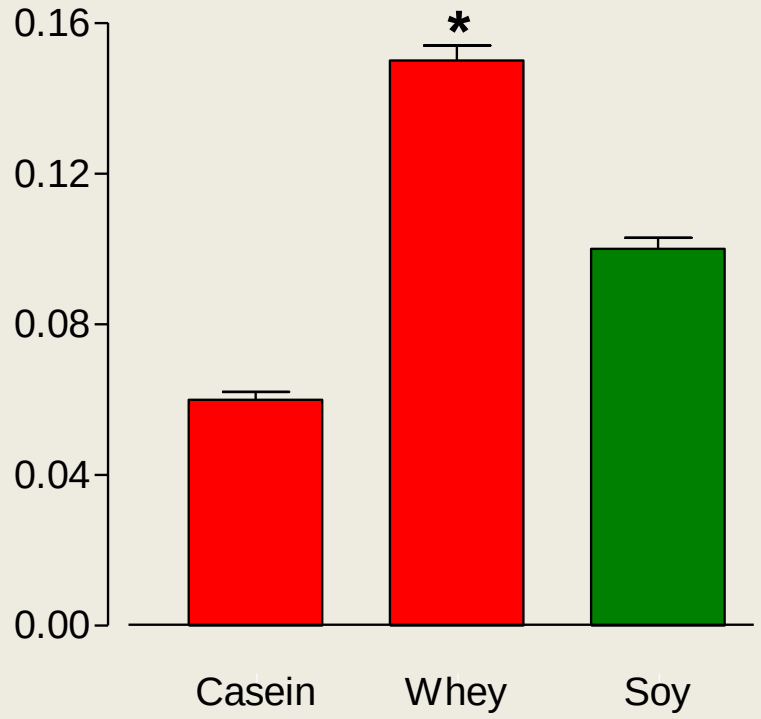

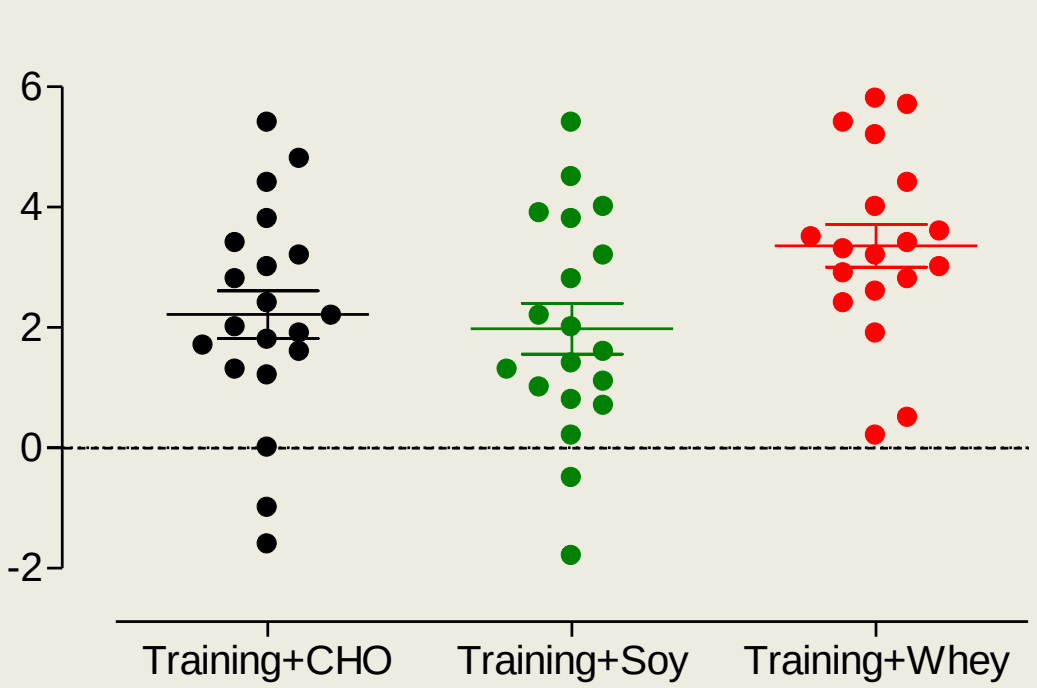

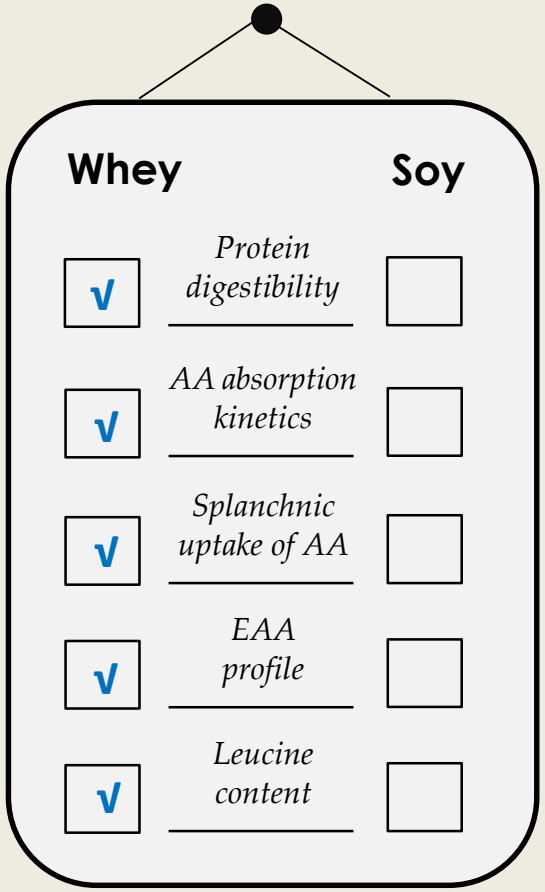

Tang *et al.* (2009), J Appl Phys

Volek *et al.* (2013), J Am Coll Nutr

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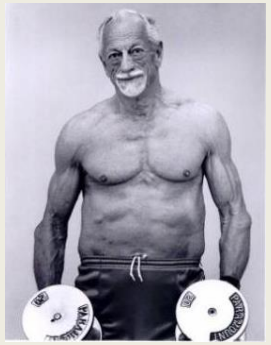

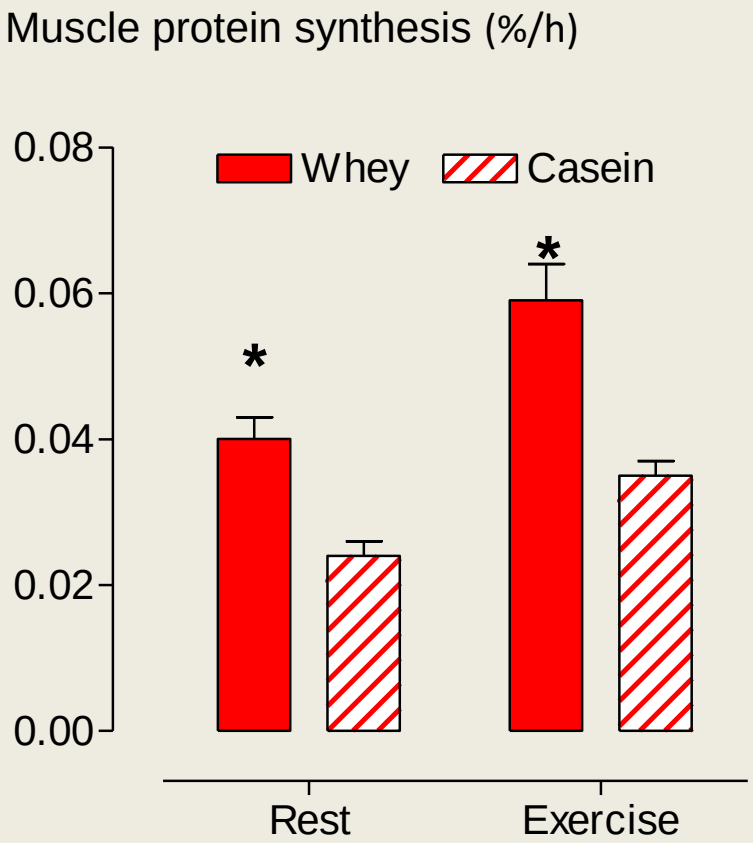

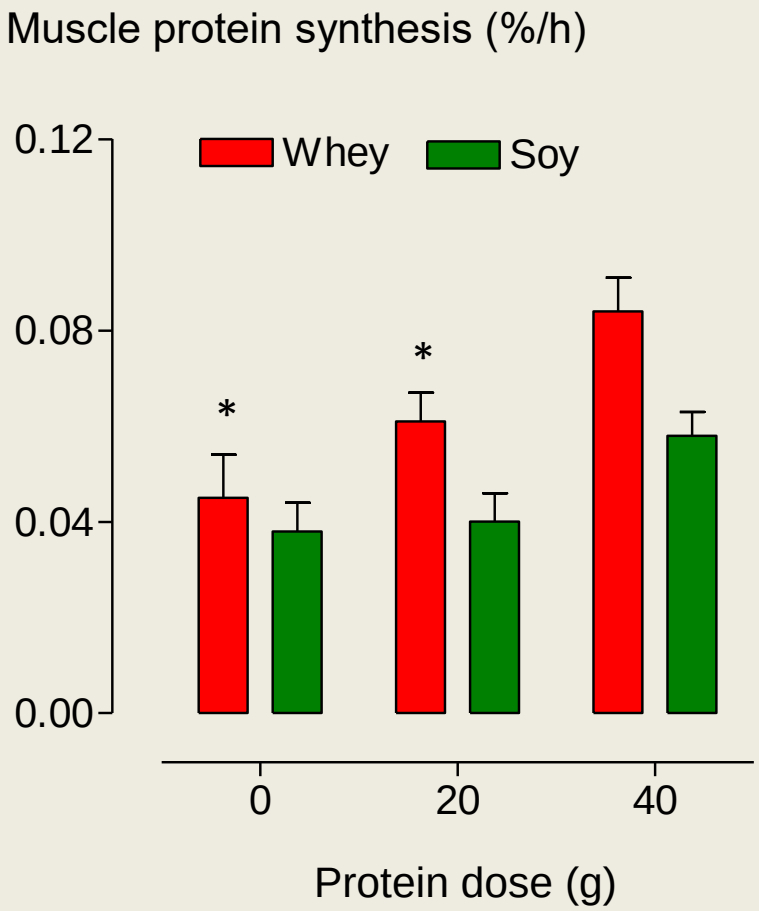

Burd et al 2009 Br J Nutr

Yang et al 2012 Nutrition and Metabolism
Yang et al 2012 Br J Nutr

Casein ingestion stimulates a greater response of myofibrillar-MPS *vs.* wheat protein in older adults

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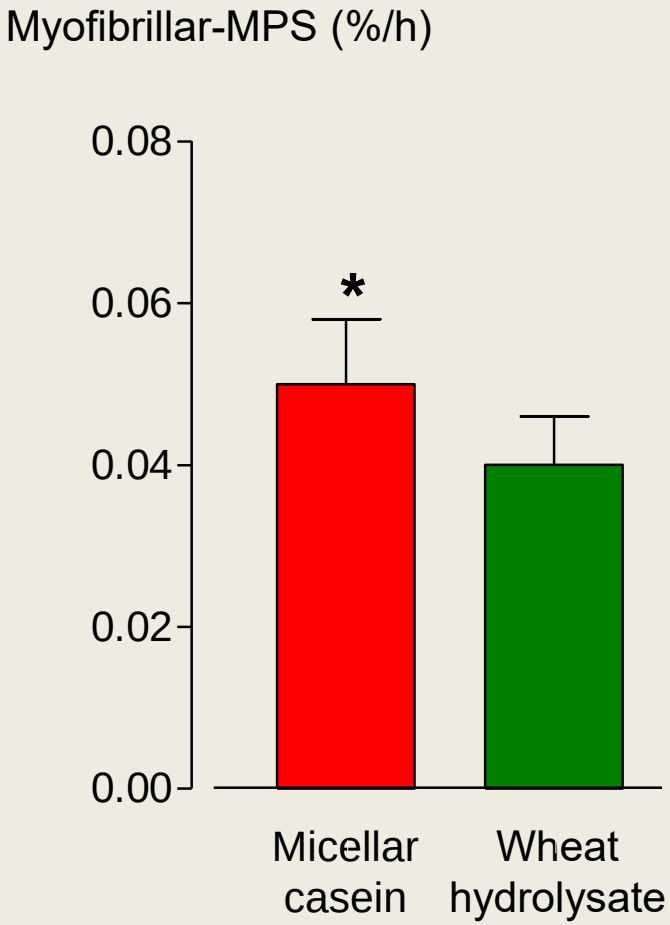

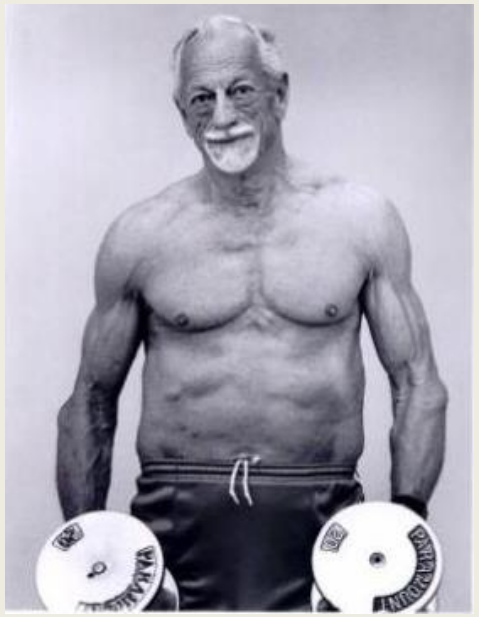

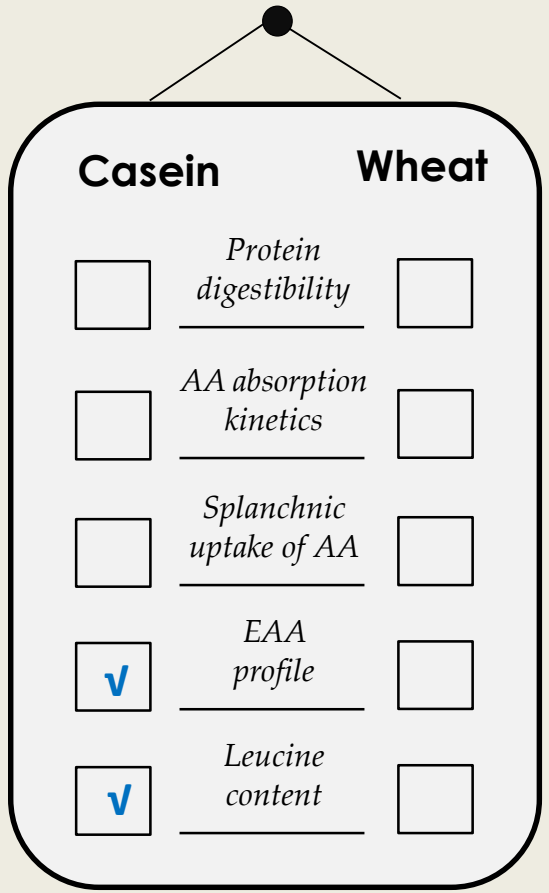

Gorissen *et al.* (2016), J. Nutr

But, what about the vegetarian athlete…….?

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Which plant proteins are complementary for stimulating muscle protein synthesis in athletes?

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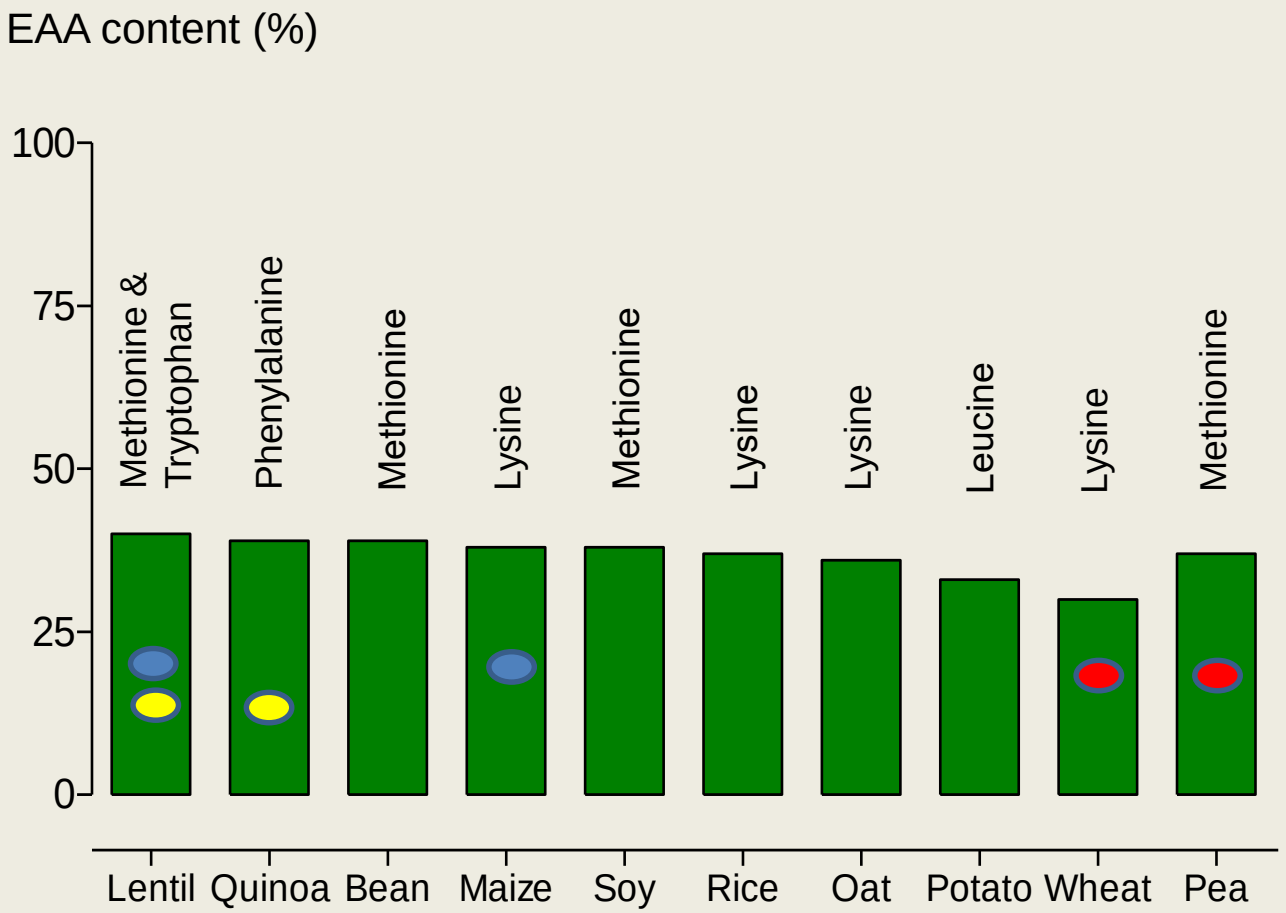

Figure adapted from **van Vliet** et al 2015 J Nutr

A food first approach: example meal plan

Quinoa, red kidney bean and green bean bowl:

- Red kidney beans, cooked (150g / 1 cup)
- White and red quinoa, cooked (100 g / ½ cup)
- Spinach, sautéed (100 g / ¼ cup)
- Peas, boiled (80 g / 1 tablespoon)
- Watercress (20 g / ½ cup)

Energy = 414 kcal
Carbohydrate = 52 g
Fat = 5 g
Protein = 25 g
Leucine = 3 g
Fibre = 26 g

….more meal plans

Butternut squash risotto

Chickpea and veg tagine

Blackbean veg curry

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……What about edible insects?

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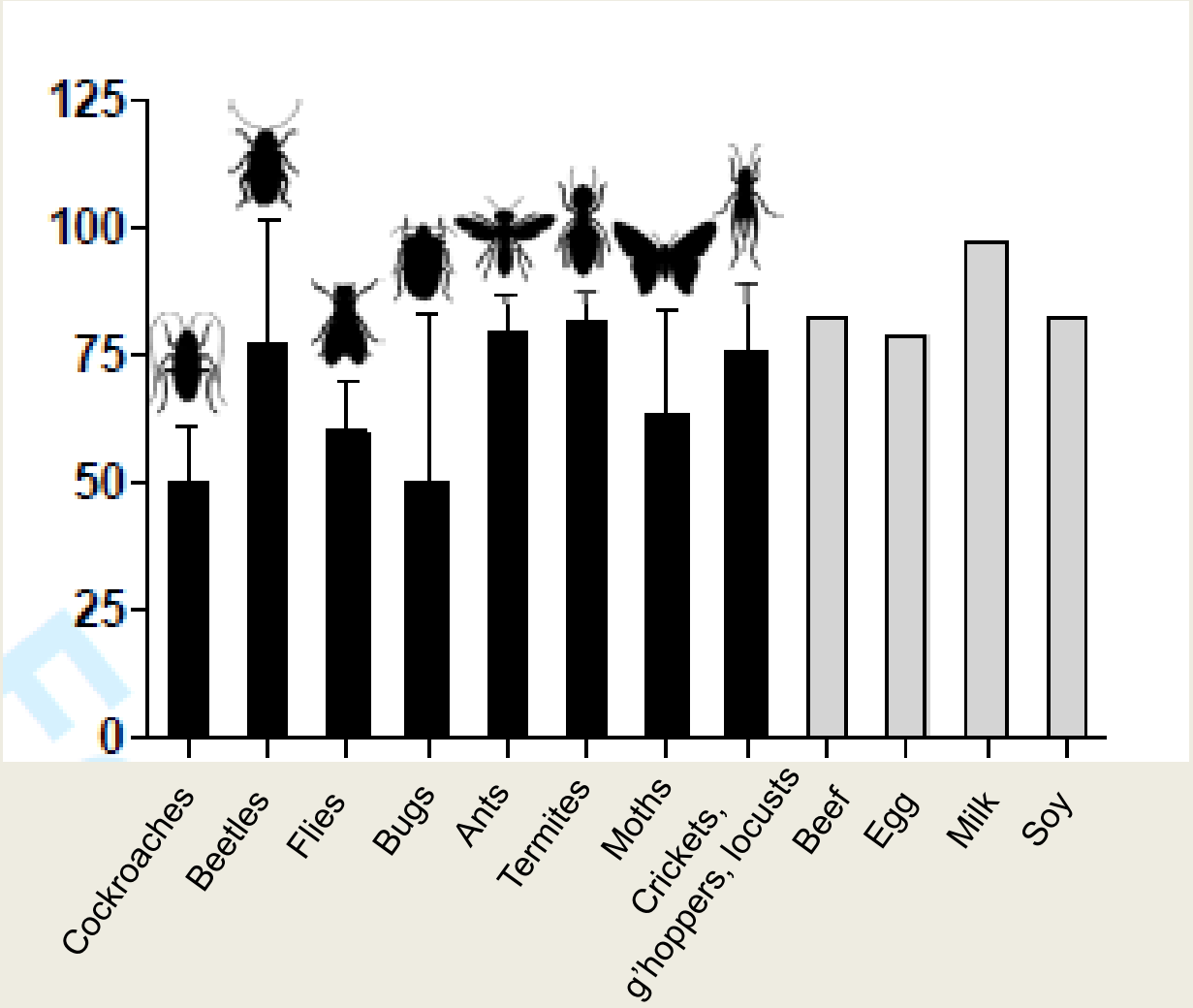

Figure adapted from **Churchward-Venne** et al • 2017 • Nutrition Reviews

Protein from dairy vs. other animal-based protein sources:

What's the difference for muscle remodelling during recovery?

Skimmed milk ingestion stimulates a similar response of MPS during exercise recovery *vs.* minced beef

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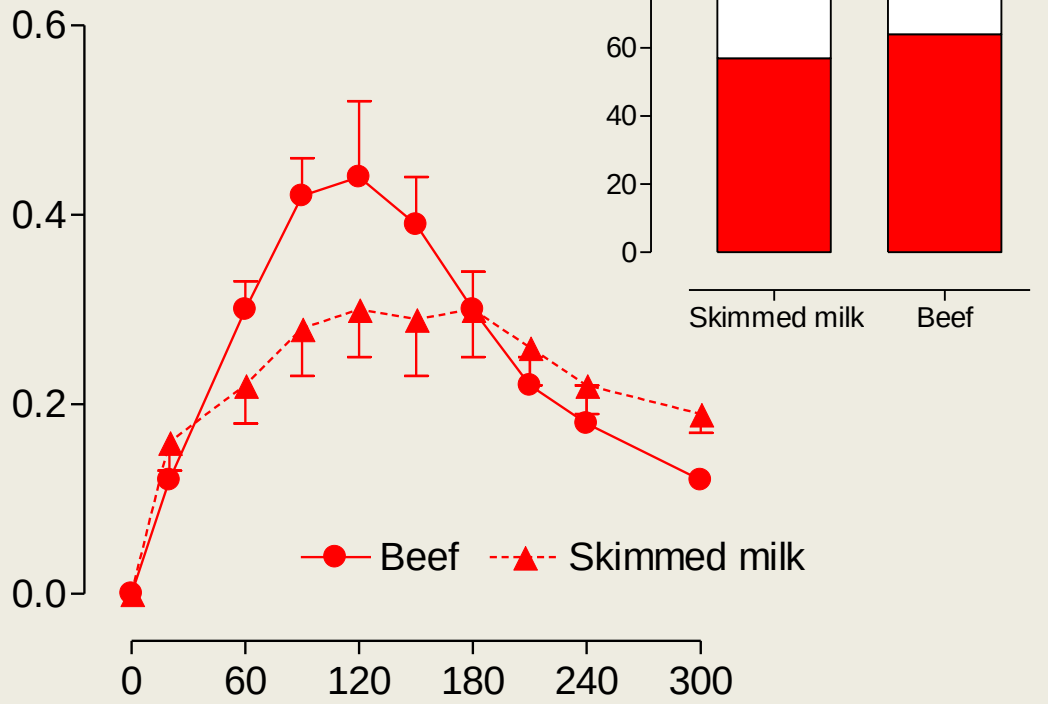

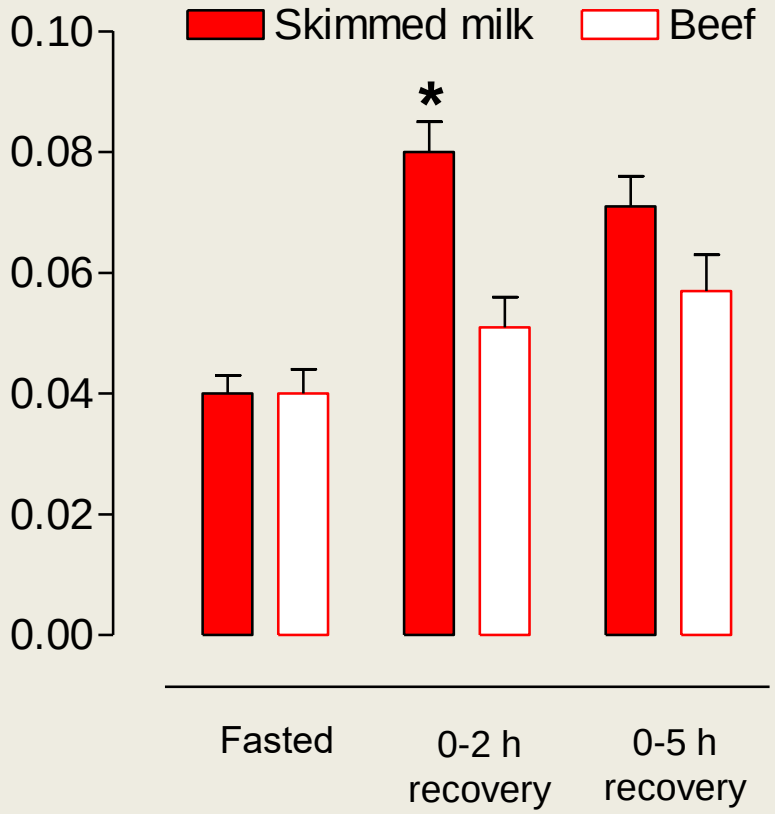

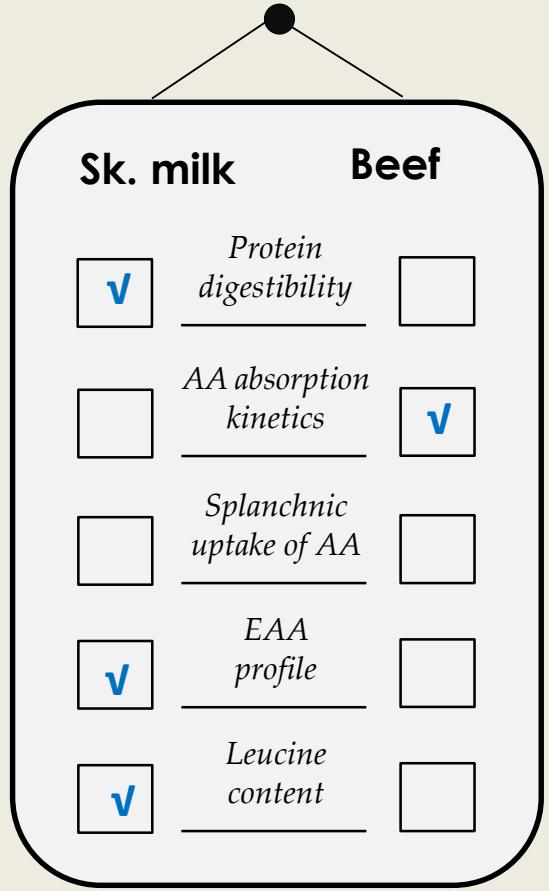

Burd *et al.* (2015), Am J Clin Nutr

Whole milk ingestion results in greater utilisation of ingested amino acids during exercise recovery *vs.* **skimmed milk**

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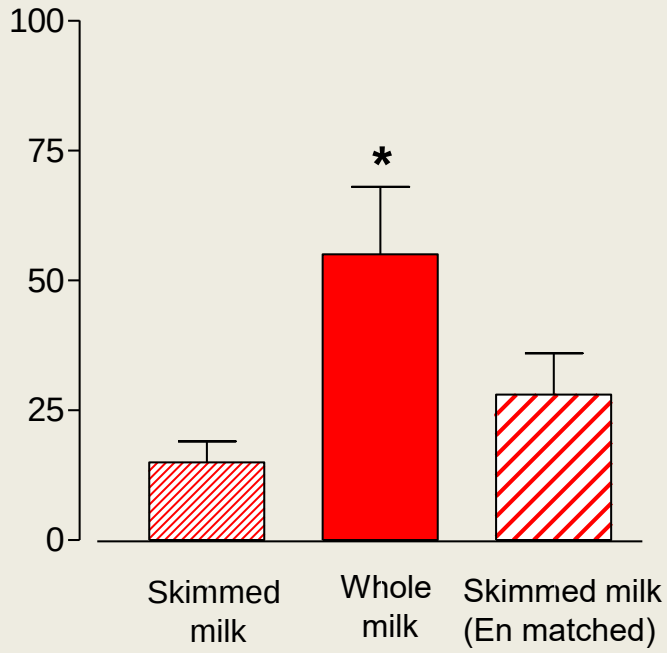
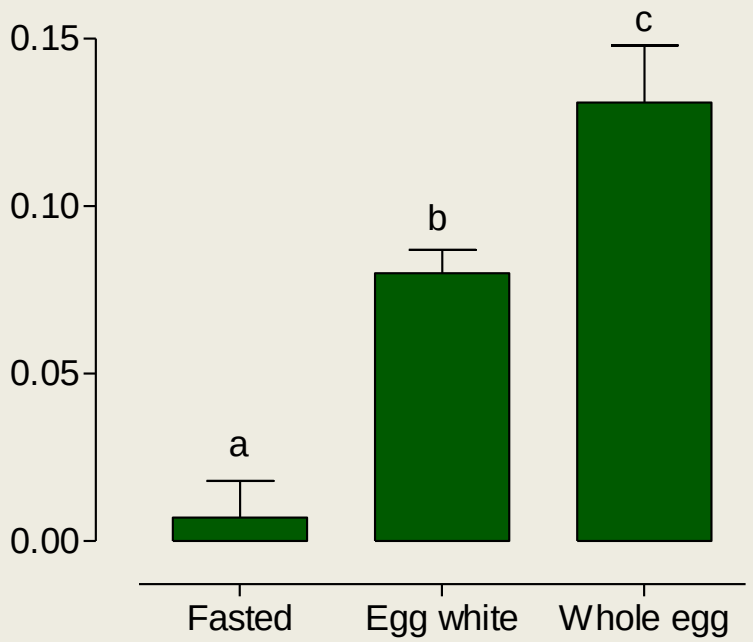
Amino acid utilisation from ingested protein
(% ingested threonine)



Myofibrillar-MPS (%/h)



Elliot et al • 2006 • Med Sci Sp Ex

Van Vliet et al • 2017 Am J Clin Nutr

Protein and environmental sustainability / food security

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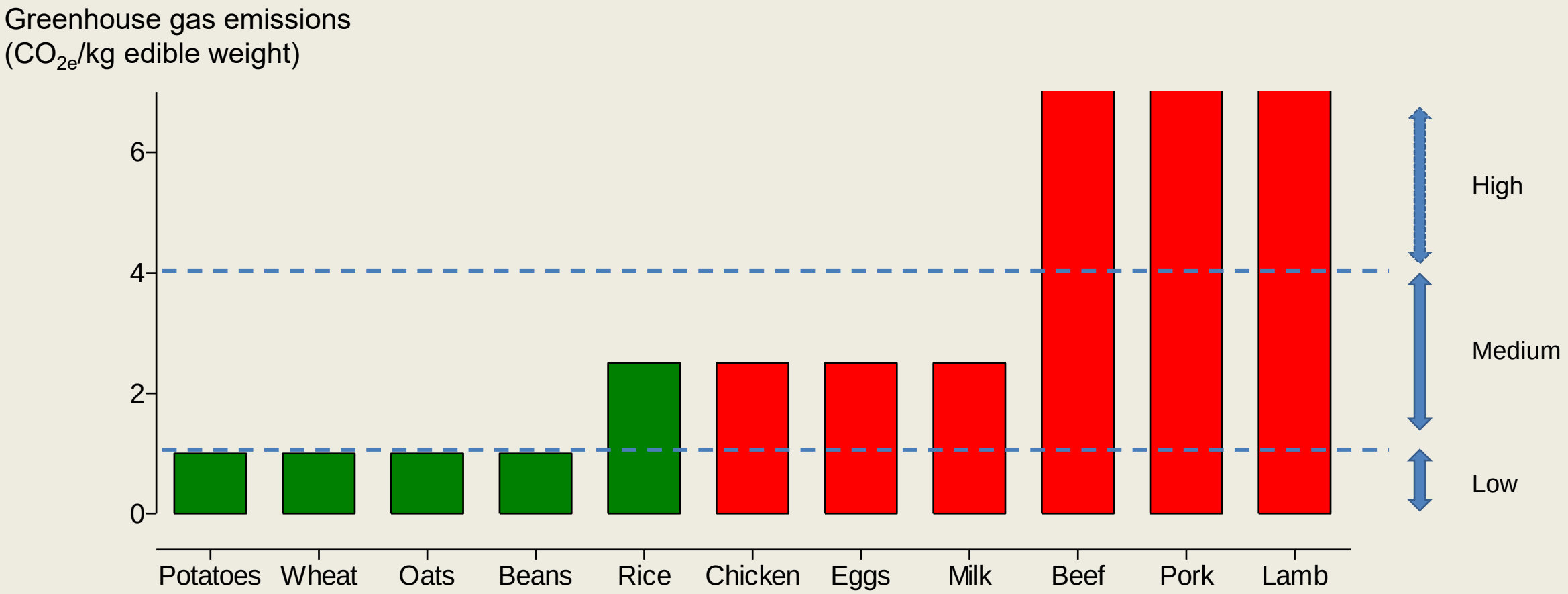

Adapted from **Macdiarmid** et al 2012 Am J Clin Nutr

What is the representative per meal dose of protein from plant-based protein for maximal stimulation of MPS?

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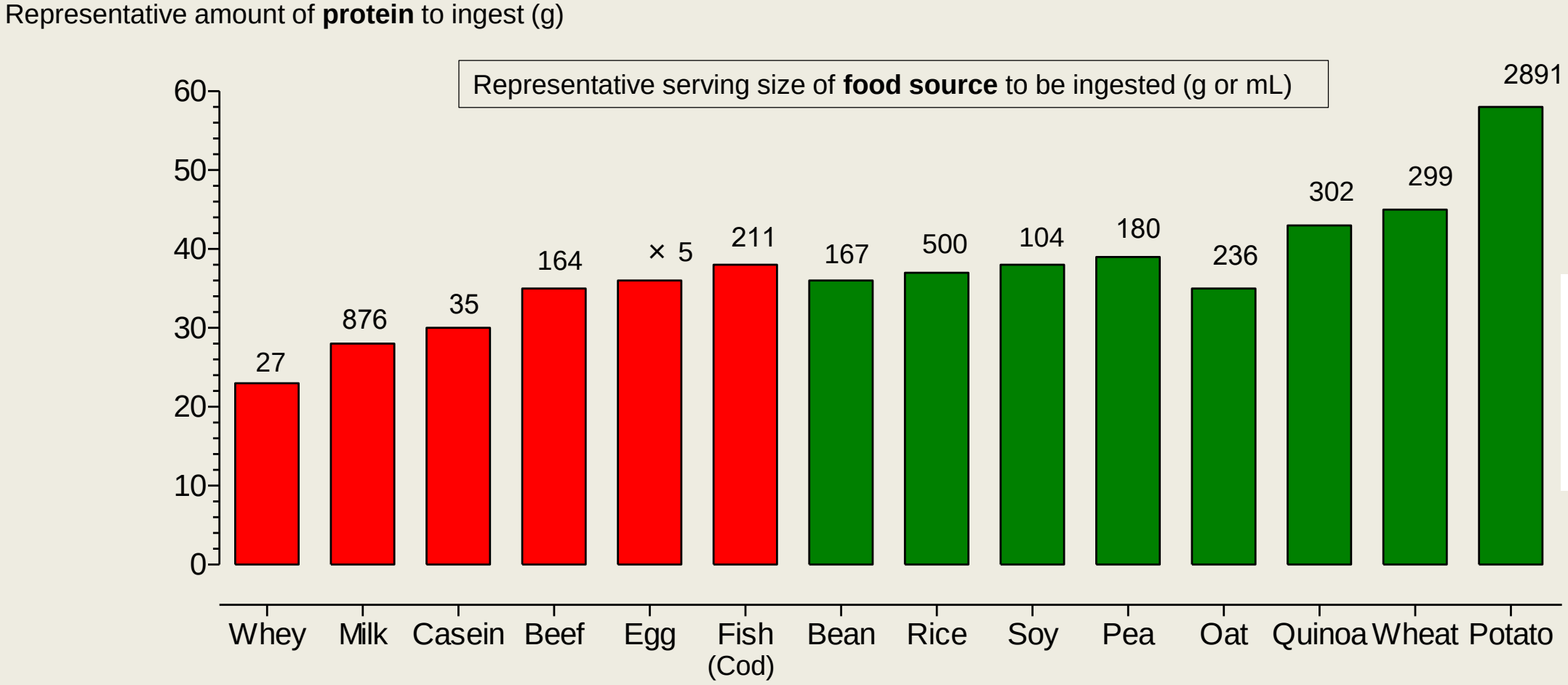

Adapted from van Vliet *et al.* (2015), J Nutr

Take home messages:
Protein from dairy, meat and plants: What's the difference for athlete recovery?

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- ✓ **Muscle remodelling** is crucially important for athlete recovery
- ✓ The potential of a protein source to promote muscle remodeling is dictated by **3 key factors**
- ✓ Gram for gram, **dairy** proteins are more potent than **soy** and **wheat** proteins for stimulating muscle protein synthesis during exercise recovery
- ✓ The notion that animal proteins, including the dairy proteins, are less **sustainable** than plant proteins may not necessarily be accurate in the context of muscle remodeling!

Dairy nutrition for muscle recovery:
Where are the gaps in research?

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- What is the **optimal dose of milk** for maximal stimulation of muscle protein synthesis after training in athletes?
- Does the ingestion of **whole milk** stimulate muscle protein synthesis to a greater extent than **skimmed milk** in athletes?
- How does casein compare to other protein sources in terms of stimulating **overnight** muscle protein synthesis in athletes?
- How potent are other dairy proteins, e.g. **yoghurt and quark**, for stimulating MPS in athletes?

What is the nutritional content of yoghurt and quark?

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	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)
Fat Free Greek Yogurt (per 100 g)	57	10.3	4.0	0
Graham's Protein 22 (per 100 g)	80	11.2	7.7	4.0
Graham's Original Quark (per 100 ml)	65	12.2	3.7	0.1

Acknowledgements

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