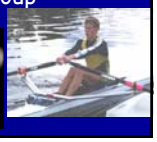
Wheying the evidence on dairy in sports

Stuart M. Phillips, Ph.D.
Exercise Metabolism Research Group
McMaster University



What I'm going to tell you

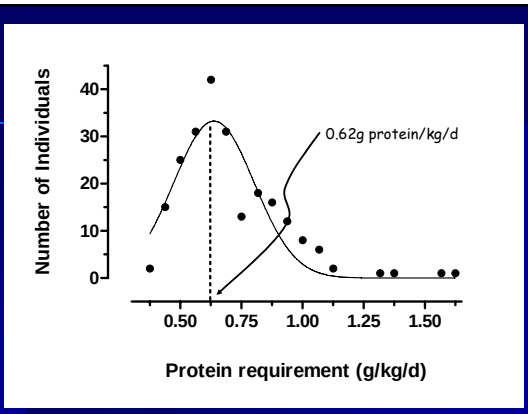
1. In sport, protein is important for recovery and restoration/repair
2. Timing of protein consumption is more important than quantity
3. Protein quality is important in determining responses to exercise, particularly resistance exercise
4. Dairy proteins are the highest quality proteins available
5. Whey protein may be a special case

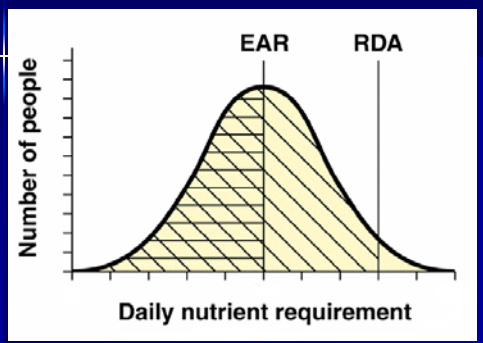
Do athletes actually need more protein?

- DRI – Institute of Medicine, 2005
- RDA – 0.80g/kg/d

"…the level of protein judged to be *adequate* … to meet the known nutrient needs for practically all healthy people."

- RDA covers:
  - Protein losses
  - Margin of error
  - Prevention of protein deficiency





What about physical activity?

Are athletes a unique subgroup?

Position stand: what the experts say about protein for athletes

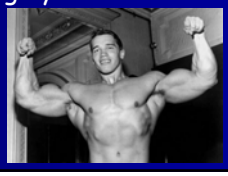
AMERICAN COLLEGE

"For endurance athletes, nitrogen balance studies in men suggest a protein recommendation of 1.2 g/kg per day (105). Little information is available regarding requirements of endurance athletes who are women. Resistance exercise is thought to increase protein requirements even more than endurance exercise, and it has been recommended that experienced male bodybuilders and strength athletes consume 1.6 to 1.7 g/kg body weight per day to allow for the accumulation and maintenance of lean tissue (82, 140)."

***2. J. Am. Diet. Assoc.* Vol. 12, pp. 1343–1356**
***3. Diet of Canada* Vol. 61, pp. 176-192**

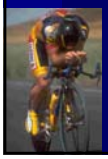
Resistance-trained/Strength Athletes 'need' more protein… right?!

- You're trying to 'grow' new muscle
- …you 'need' more protein!!
- Resistance training damages muscle
- To repair the damage you need more protein

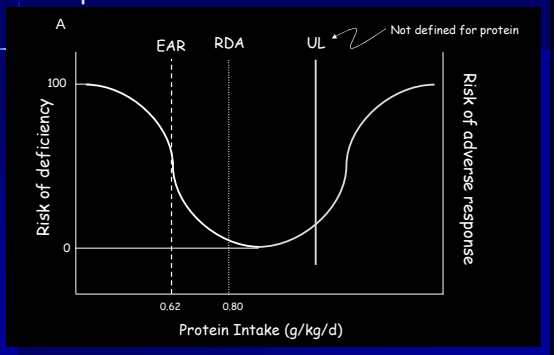


Endurance-trained Athletes

- High energy flux
- AA oxidation – between 1-3% of total EE
- Large EE = Large AA oxidation

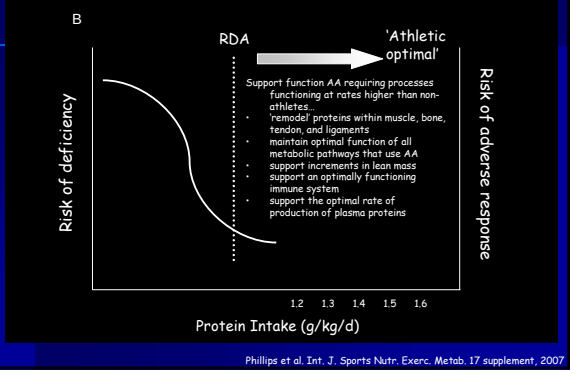


The DRI Model for Protein Requirements



Phillips et al. Int. J. Sports Nutr. Exerc. Metab. 17 supplement, 2007

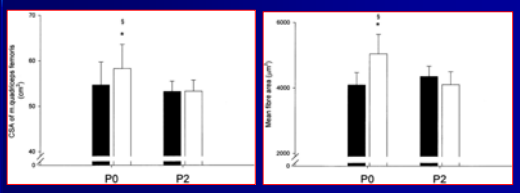
The 'athlete' DRI model



Phillips et al. Int. J. Sports Nutr. Exerc. Metab. 17 supplement, 2007

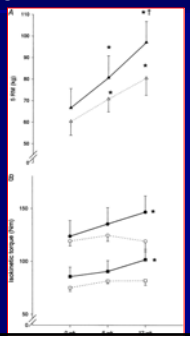
Protein: Timing of ingestion may be more important than quantity

Delaying the consumption of protein post-exercise ablates hypertrophic gains in elderly men



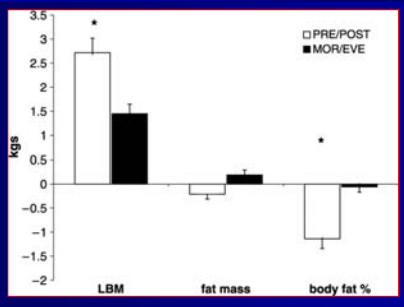
Esmarck et al, J Physiol. 2001

Delaying the consumption of protein post-exercise slows strength gains in elderly men



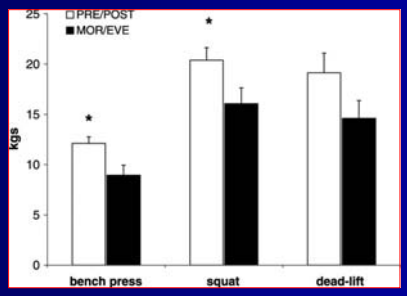
Esmarck et al, J Physiol. 2001

Consumption of protein in close temporal proximity to exercise is beneficial for hypertrophy



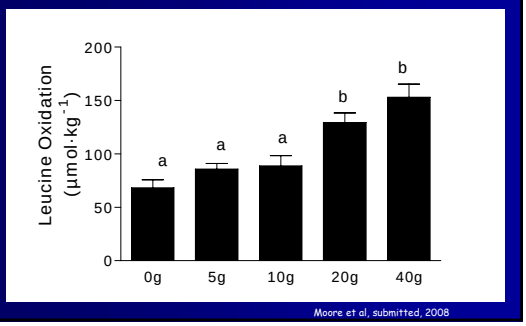
Cribb & Hayes Med Sci Sports Exerc. 2006

Consumption of protein in close temporal proximity to exercise is beneficial for strength gains



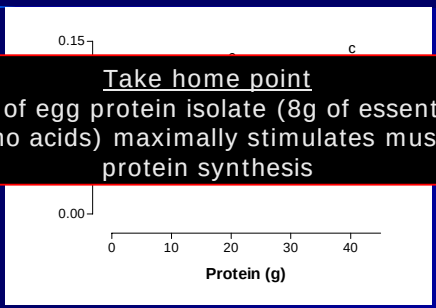
Cribb & Hayes Med Sci Sports Exerc. 2006

Stimulation of leucine oxidation at a dose >10g of whole protein



Moore et al, submitted, 2008

Maximal rate of muscle protein synthesis at 20g of protein

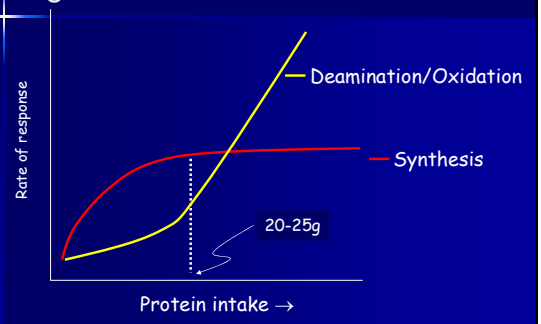


Take home point

20g of egg protein isolate (8g of essential amino acids) maximally stimulates muscle protein synthesis

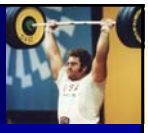
Moore et al, submitted, 2008

Too little, Too much, or just right?



Protein quality appears to be important in determining muscle gains

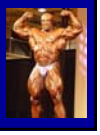
Hypertrophy requires positive protein balance



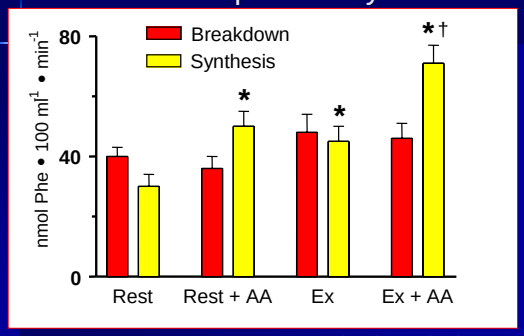
- Hypertrophy - muscle protein BALANCE must be positive

SYNTHESIS > BREAKDOWN

- This change must be occurring chronically

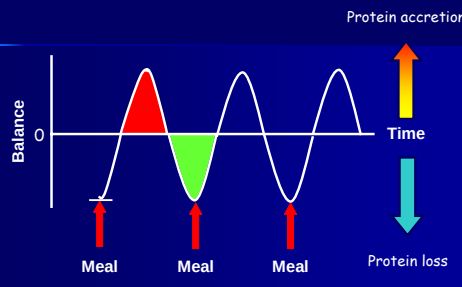


Feeding & Exercise: synergistic activators of protein synthesis



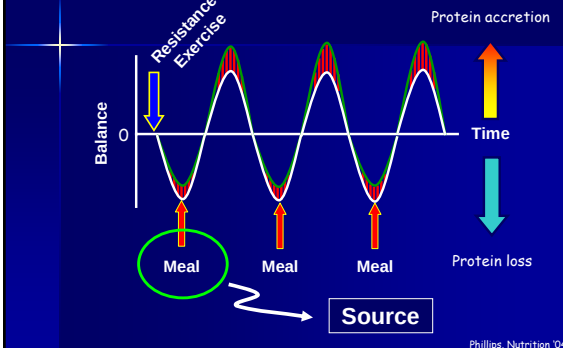
Biolo et al. Am. J. Physiol. '95
Biolo et al. Am. J. Physiol. '97

Muscle Protein Balance fluctuates with feeding throughout the day



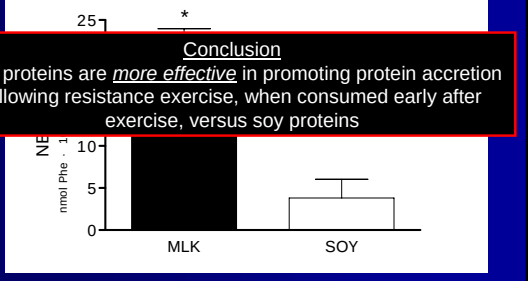
Phillips. Nutrition '04

Muscle Protein Balance is enhanced further by exercise



Phillips. Nutrition '04

Post-exercise consumption of milk promotes greater net balance than soy

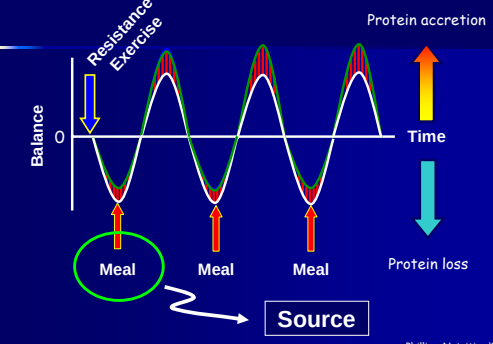


Conclusion

Milk proteins are *more effective* in promoting protein accretion following resistance exercise, when consumed early after exercise, versus soy proteins

Wilkinson et al. *Am J Clin Nutr* 2007;85:1031- 40

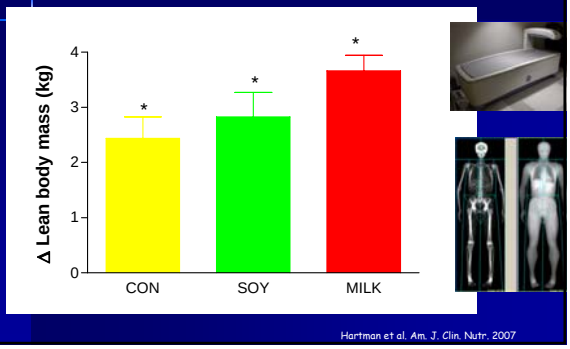
Muscle Protein Balance is enhanced further by exercise



Phillips. Nutrition '04

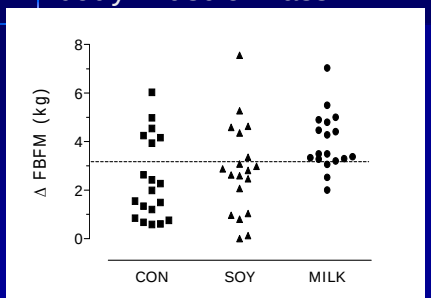
Hypothesis: Chronic consumption of milk versus soy or isoenergetic energy as carbohydrate will promote greater gains in muscle mass

12 weeks of resistance training with milk consumption promotes greater lean mass gains



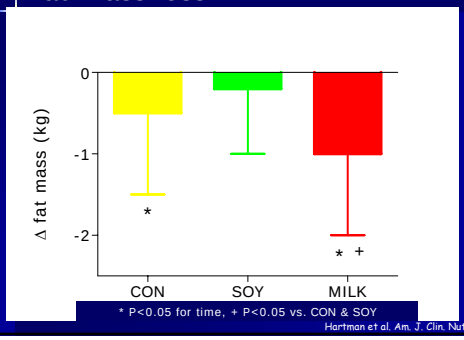
Hartman et al. Am. J. Clin. Nutr. 2007

Individual changes in whole body muscle mass



Hartman et al. Am. J. Clin. Nutr. 2007

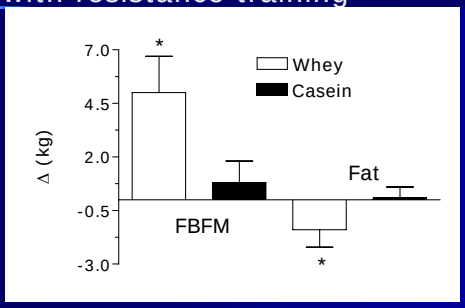
12 weeks of resistance training with milk consumption promotes fat mass loss



* P<0.05 for time, + P<0.05 vs. CON & SOY

Hartman et al. Am. J. Clin. Nutr. 2007

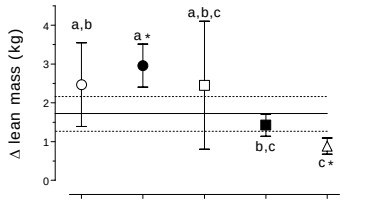
Whey promotes greater gains in muscle mass than casein with resistance training



Cribb and Hayes Int. J. Sports Nutr. Exerc. Metab, 2006

Whey promotes superior gains in muscle mass versus other proteins

N = 306 – 247 men and 43 women



Phillips et al, J. Am. Coll. Nutr., 2008, in press

Why does whey 'work' so well?

The usual suspects

Adding Muscle

- Protein…
  - ~~Quantity?~~
  - Quality?
  - BCAA?
  - Leucine?
- Vit D

Losing fat

- Calcium…
  - Binding fat?
  - Promoting lipolysis?
  - Promoting adipocyte apoptosis?
- Protein…
  - BCAA…leucine promote lipolysis

AA composition, PDCAAS, and NPU in proteins and soy

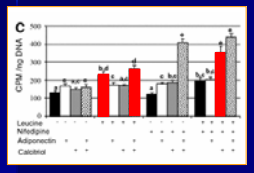
Amino acid content (mg/g)	Milk solids (non-fat) [a]	Casein [b]	Whey [c]	Soy [d]	Body protein [e]
Histidine	20	27	20	28	27
Isoleucine	63	54	76	44	35
Leucine	77	82	108	62	75
Lysine	54	73	101	62	73
Methionine (+ Cys)	33	28	48	20	35
Phenylalanine (+ Tyr)	48	100	67	88	73
Threonine	37	54	44	32	42
Trypotophan	15	12	26	10	12
Valine	55	64	72	54	49
PDCAAS	121 [f]	123 [g]	115 [g]	104 [h]	
NPU	86 [i]	78 [i]	92 [i]	72 [i]	

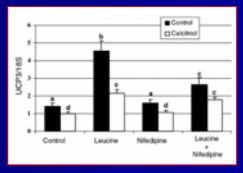
Lipids (2007) 42:297–305
DOI 10.1007/s11745-007-3029-5

ORIGINAL ARTICLE

Leucine and Calcium Regulate Fat Metabolism and Energy Partitioning in Murine Adipocytes and Muscle Cells

Xiaocun Sun · Michael B Zemel





Leucine…
- Stimulates FA oxidation
- Opposes the action of $1,25(OH)_2$-D

Leucine…
- Increases UCP3 expression
- Attenuates calcitriol effect

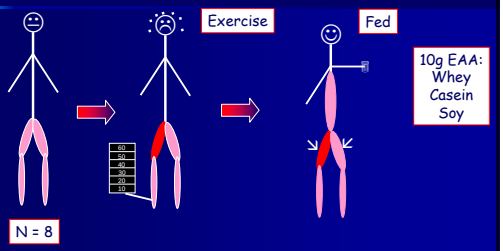
Extra whey protein (60g/d) in the diet promotes weight loss

"…supplemental whey protein, compared to soy protein and an isocaloric amount of carbohydrate, on body weight and composition in free-living, overweight and obese (BMI > 28 and < 38) but otherwise healthy individuals."

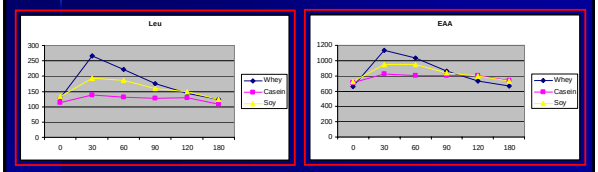
- N=90 for 6mo: 1) 60 g/d of whey protein, 2) 60 g/d of soy protein or 3) a control group receiving 60 g/d of carbohydrate.
- After 6 mo, body weight of the group consuming the whey protein was 1.8 ± 0.6 kg (2%) lower than the group consuming the carbohydrate treatment (P<0.006).
- After 6 mo, body fat (BodPod) was 2.3 ± 0.8 kg lower in the group consuming the whey protein compared to the group consuming the carbohydrate treatment (P<0.005). Lean body mass was not different among groups.
- Waist circumference was lower (P<0.0001) in the group consuming the whey protein than the two other groups.

Baer et al FASEB J. 20: A427, 2006

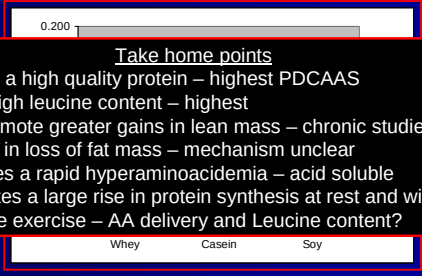
The unilateral exercise model



The rise in AA is more rapid with whey ingestion



Whey promotes a greater increase in both rested and exercised protein synthesis



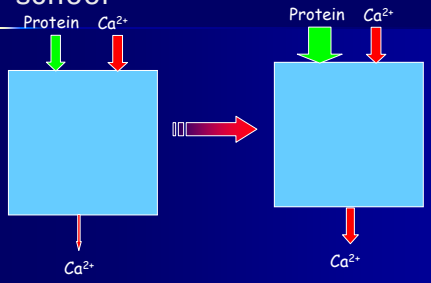
Take home points

- Whey is a high quality protein – highest PDCAAS
- Has a high leucine content – highest
- Can promote greater gains in lean mass – chronic studies
- May aid in loss of fat mass – mechanism unclear
- Promotes a rapid hyperaminoacidemia – acid soluble
- Stimulates a large rise in protein synthesis at rest and with resistance exercise – AA delivery and Leucine content?

1. Athletes do not likely need more protein
2. It may be advantageous to consume extra protein above the RDA
3. Consumption of protein should be in close temporal proximity to resistance exercise
4. Milk proteins are superior to soy and energy as carbohydrate in promoting lean mass gain
5. The active protein in milk may well be whey
6. As a high quality protein, whey promotes rapid hyperaminoacidemia and increases in protein synthesis; leucine effects remain unstudied

T H A N K Y O U

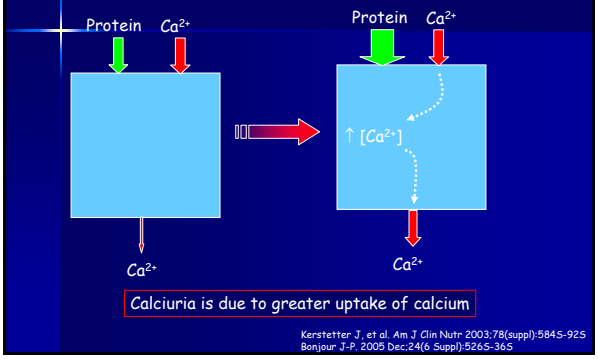
Dietary protein and Bone… old school



∴ Increased protein causes calciuria and will ultimately weaken bone

Feskanich D, et al. Am J Epidemiol 1996;143:472-9
Cooper C, et al. Calcif Tissue Int 1996;58:320-25

Dietary protein and Bone…the new view



Kerstetter J, et al. Am J Clin Nutr 2003;78(suppl):584S-92S
Bonjour J-P. 2005 Dec;24(6 Suppl):526S-36S

Higher protein diets and renal disease

- In the most recent round of discussions in setting the new DRI, the IOM concluded, "…that protein content of diet is not related to progressive decline in kidney function with age."
- E.L. Knight et al. *Ann Intern Med* **138:** 460–467, 2003. Stated, "… [there was] no significant association between protein intake and change in glomerular filtration rate in women with normal renal function, and a sub-analysis of animal protein, dairy protein, and vegetable protein showed that none of the individual sources of protein were associated with a change in glomerular filtration rate in women with normal renal function."
- From these studies, it is difficult to conclude whether or not there is a long-term association between amount of animal or vegetable protein intake and change in normal renal function. Bernstein et al. JADA 2007 Apr;107(4):644-50 .