

**AN UPDATE ON POST-EXERCISE RECOVERY STRATEGIES: A ROLE FOR MILK?**

Health & Exercise Sciences Research Group  
UNIVERSITY OF STIRLING  
Scotland's University for Sporting Excellence

**Kevin Tipton, PhD**  
Professor of Sport, Health and Exercise Sciences  
University of Stirling

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[k.d.tipton@stir.ac.uk](mailto:k.d.tipton@stir.ac.uk)  
<http://www.sports.stir.ac.uk/staff/kevin-tipton.php>  
@Stirproftip

**What nutrition-related factors are important for optimal recovery?**

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- **Increased muscle protein synthesis**
  - ❖ Repair damage
  - ❖ Adaptations
- **Muscle damage/soreness**
- **Hydration**
- **Immune function**
- **Replenish energy stores**
  - ❖ Muscle glycogen
  - ❖ Intramuscular triglycerides

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**What I'll tell you about**

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- **Why is muscle protein synthesis important for recovery?**
- **Dairy proteins and muscle protein synthesis with exercise**
- **Dairy proteins and muscle recovery from intense exercise**
  - ❖ Muscle function/soreness
  - ❖ Immune function
  - ❖ Rehydration

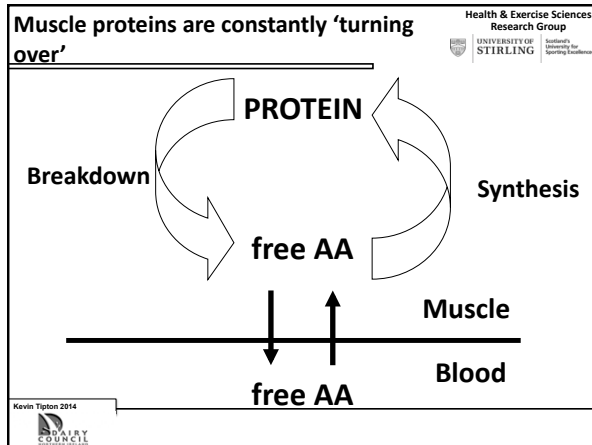
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**The metabolic basis for repair of muscle proteins**

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**Muscle protein synthesis AND breakdown**

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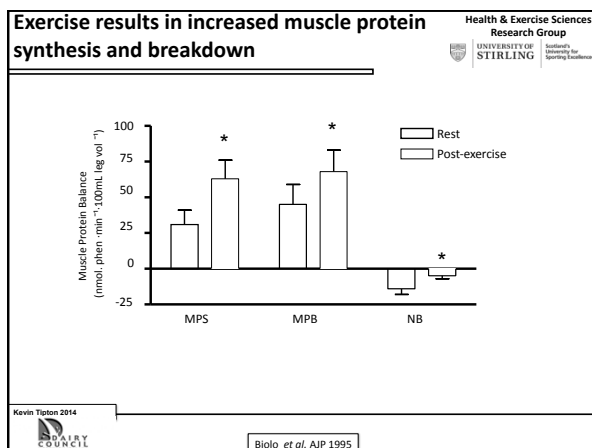


### The metabolic basis for changes in muscle proteins is net muscle protein balance

Protein Synthesis - Protein Breakdown = net protein balance

PB exceeds PS = negative protein balance → protein loss  
PS exceeds PB = positive protein balance → protein gain

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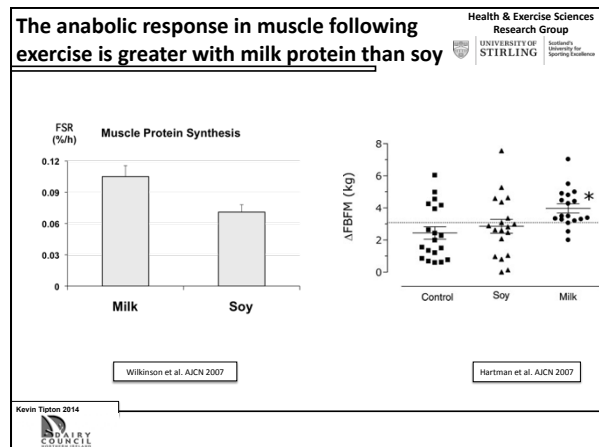
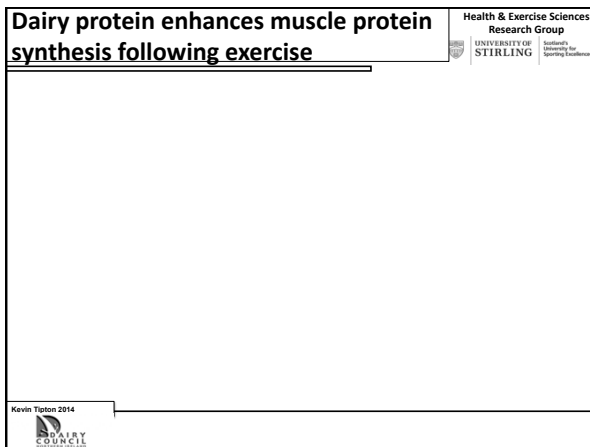
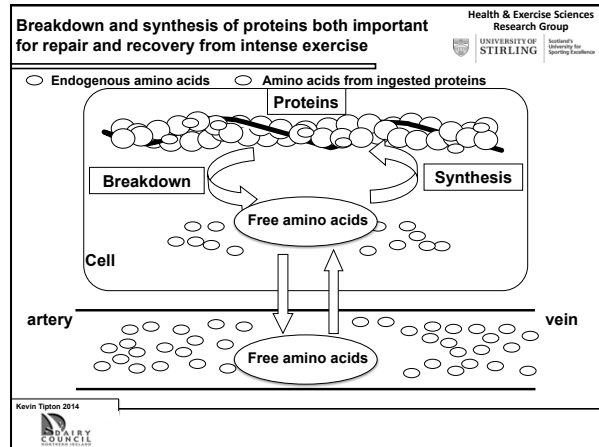
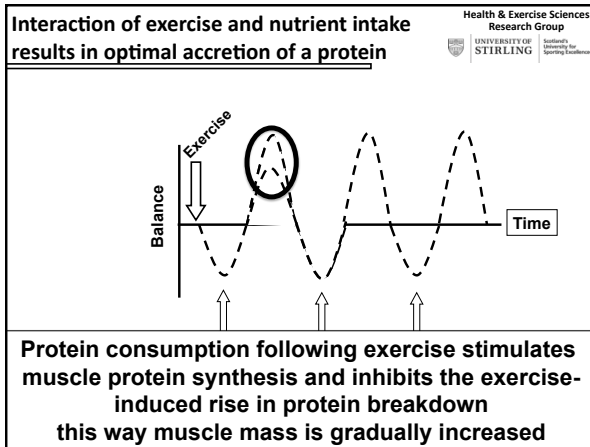
### Protein increases net muscle protein balance primarily thru changes in MPS

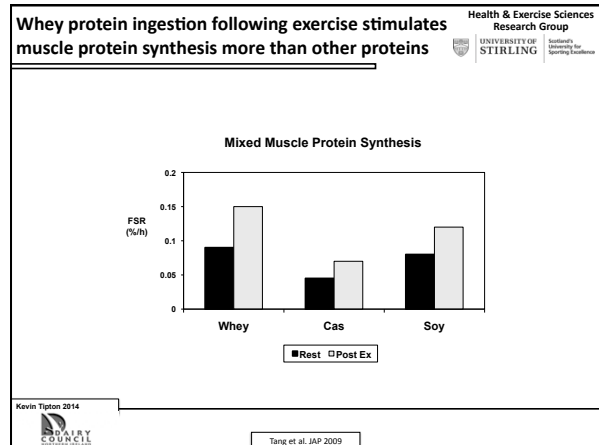
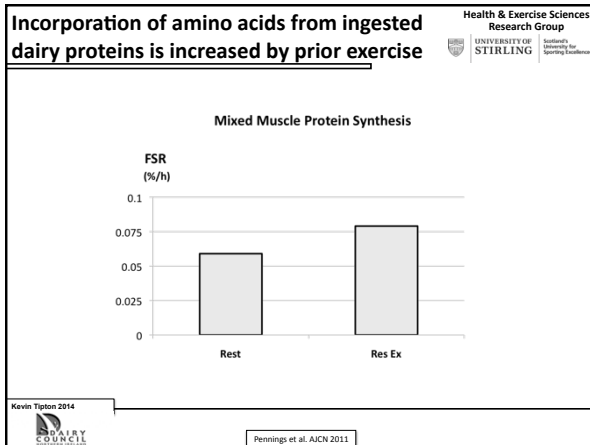
↑ net muscle protein balance

↑ Protein synthesis  
must exceed

↑ Protein breakdown

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### Dairy Protein and Recovery from Intense Exercise

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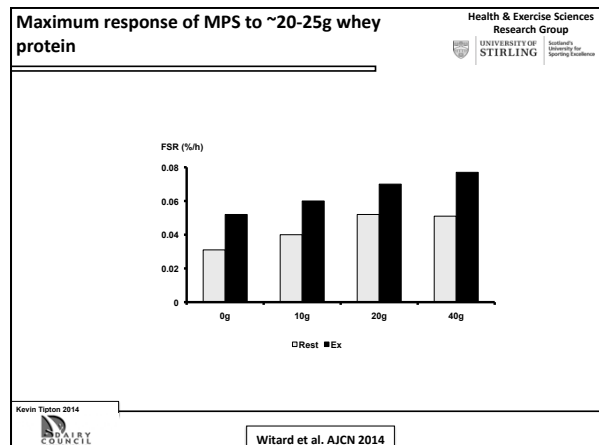
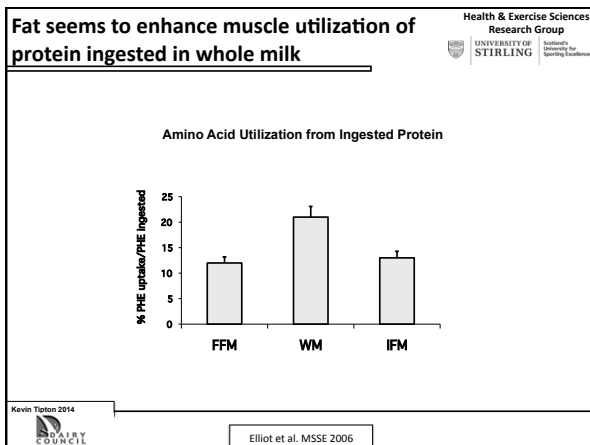
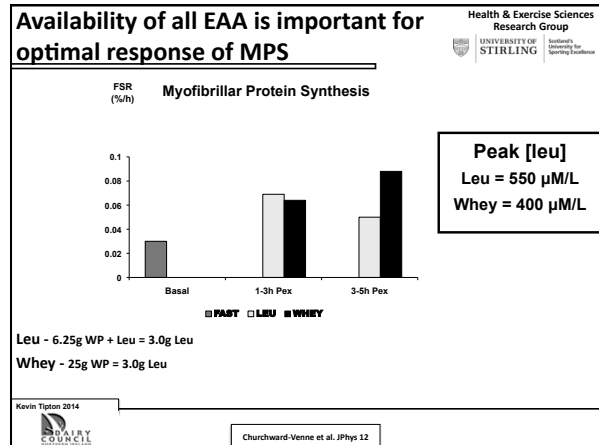
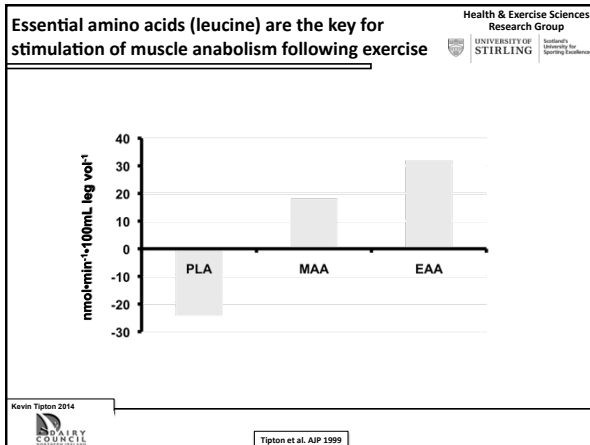
- The response of MPS to dairy proteins following exercise is superior to plant proteins
- Ingestion of dairy proteins protein with training results in muscle protein accretion

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### Factors that impact the response of muscle protein synthesis to milk ingestion

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**Dairy Protein and Recovery from Intense Exercise**

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- Milk provides the essential amino acids, including leucine, to optimize synthesis of muscle proteins following resistance exercise
- Milk fat may enhance utilization of ingested milk proteins following exercise
- Approximately 0.25-0.30 g whey protein/kg is maximizes response of MPS

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**Dairy proteins and endurance exercise**

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**MPS is greater with milk ingestion after endurance exercise**

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Mixed Muscle Protein Synthesis

FSR (%/h)

**What proteins are being synthesized?**

Group	FSR (%/h)
CON	~0.06
MILK	~0.08

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Lunn et al MSSE 2012

**Metabolic response of individual proteins may respond differently to training and nutritional stimuli.**

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**When protein ingestion increases muscle myofibrillar protein synthesis following intense cycling**

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FSR (%/h)

**What is significance of increased muscle myofibrillar protein synthesis following endurance exercise?**

Category	CHO	CHO+PRO
Myof	~0.015	~0.022
Mito	~0.012	~0.018

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Breen et al JPhys 2011

**Protein may be more important for transcriptional response to endurance exercise**

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**Protein may impact transcriptome later than 4h following exercise**

**Protein intake enhances the expression of genes involved in type I myofibril remodeling and enhanced cellular energy pathways (e.g. peroxisome proliferator-activated receptor gamma family expression)**

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Rowlands et al Phys Gen 2011

**Dairy Protein and Recovery from Endurance Exercise**

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- The significance of the immediate translational response to dairy protein ingestion following endurance exercise is unknown
- Dairy protein ingestion following endurance exercise may influence transcriptional response of metabolic genes involved with adaptation to training

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**Dairy protein and recovery from intense exercise**

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