Does protein improve training adaptations? A role for milk proteins?

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Belfast, Northern Ireland
October, 2012

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Skeletal muscle plasticity

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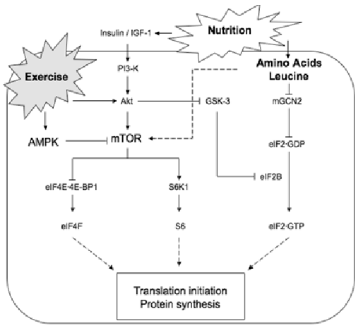
Interaction between nutrition and exercise



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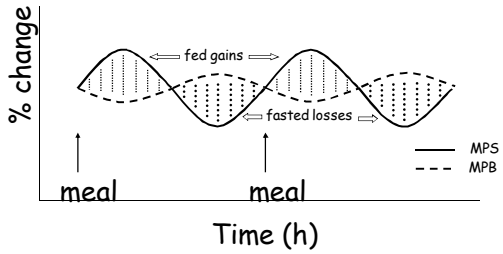
Muscle protein balance



Burd *et al*., *J Appl Physiol*, 2009

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Nutrition and post-exercise reconditioning

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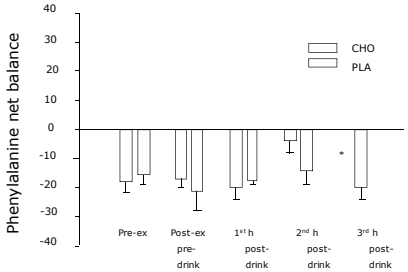
Post-exercise carbohydrate ingestion



Borsheim *et al*., *J Appl Physiol*,2004.

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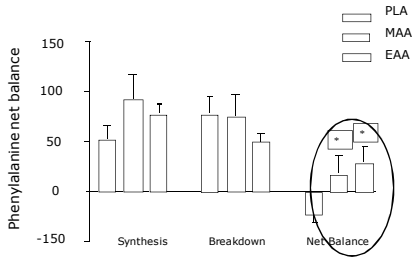
Post-exercise amino acid ingestion



Tipton *et al., Am J Physiol, 1999*

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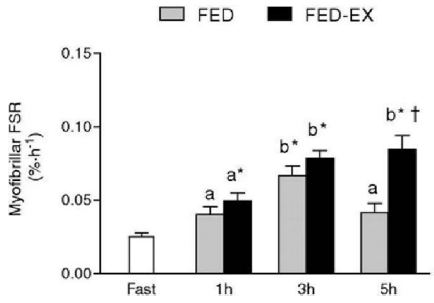
Protein ingestion increases muscle protein synthesis



Moore *et al., J Physiol*, 2009.

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Post-exercise muscle protein synthesis


- amount of dietary protein


- type of protein


- carbohydrate (nutrient) co-ingestion


- timing of protein ingestion

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Amount of dietary protein

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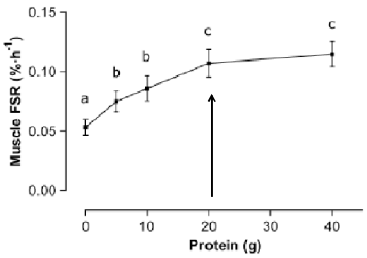
Amount of dietary protein



Moore et al., J.Physiol, 2009

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Type of dietary protein

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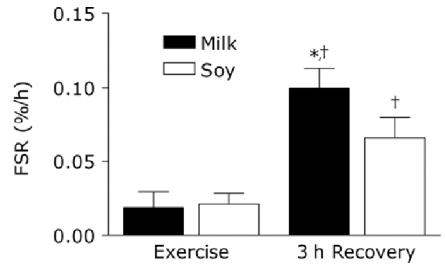
Milk versus soy protein



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

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Carbohydrate co-ingestion

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Does protein co-ingestion during endurance exercise improve performance?

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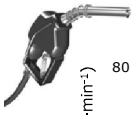
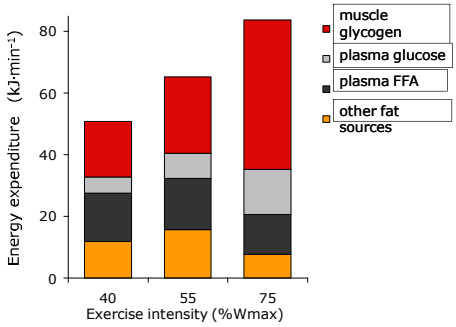
Substrate use during exercise





van Loon *et al., J. Physiol.,* 2001

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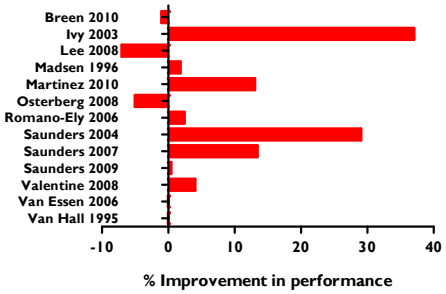
Endurance performance improvement with protein-carbohydrate ingestion



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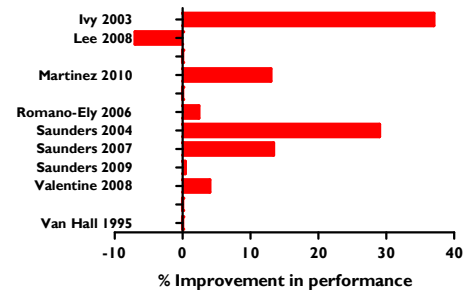
Endurance performance improvement using TTE



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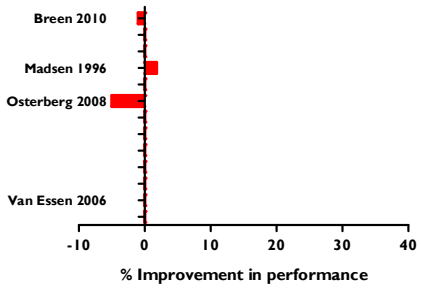
Endurance performance improvement using STT



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Does protein carbohydrate co-ingestion post endurance exercise improve recovery?

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Recovery from endurance exercise

Repletion of endogenous glycogen stores

Facilitate skeletal muscle adaptive response

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Carbohydrate plus protein ingestion

Accelerated glycogen repletion	No effect
Zawadzki *et al.*, 1992	Jentjens *et al.*, 2001
van Loon *et al.*, 2000	van Hall *et al.*, 2000
Ivy *et al.*, 2002	Howarth *et al.*, 2009
Berardi *et al.*, 2006	Beelen *et al.*, 2011

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Carbohydrate plus protein ingestion

≤ 0.8 g/kg/h	≥ 1.2 g/kg/h
Zawadzki *et al.*, 1992	Jentjens *et al.*, 2001
van Loon *et al.*, 2000	van Hall *et al.*, 2000
Ivy *et al.*, 2002	Howarth *et al.*, 2009
Berardi *et al.*, 2006	Beelen et al., 2011

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Carbohydrate-protein co-ingestion

Co-ingestion of protein and/or an amino acid mixture with up to 0.8 g/kg/h carbohydrate accelerates post-exercise muscle glycogen repletion

Glycogen resynthesis = more efficient!

Beelen *et al., Int. J . Sports Nutr. Exerc. Metab.*, 2010

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Timing of protein ingestion

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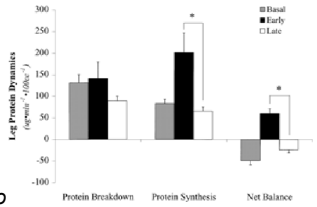
Timing of protein ingestion

ÔWhole-body and leg protein synthesis, as well as net protein deposition, are enhanced when nutrients are consumed immediately after exercise, as opposed to 3 h later.Ô



Levenhagen *et al., Am. J. Physiol.*, 2001.

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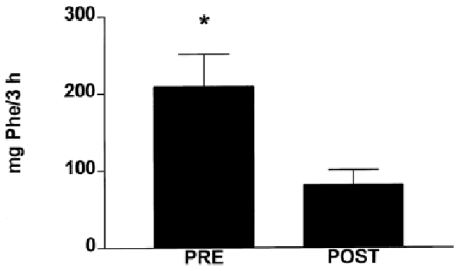
Protein ingestion prior to exercise



Tipton *et al., Am. J. Physiol.*, 2001.

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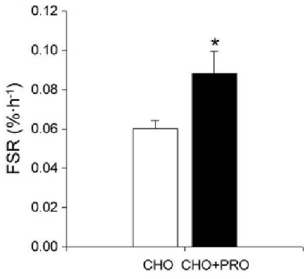
Protein ingestion during resistance exercise



Beelen *et al., Am. J. Physiol.*, 2008.

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Protein ingestion *during* endurance exercise to facilitate post-exercise recovery?

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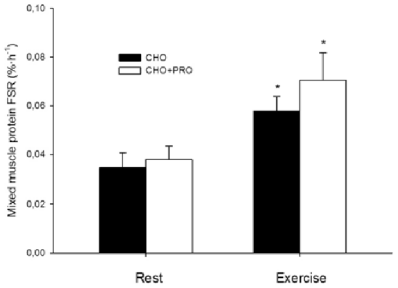
Protein ingestion during endurance type exercise



Beelen *et al., Am J Physiol*, 2011

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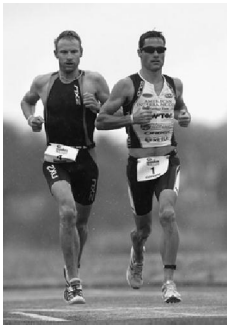
Protein-carbohydrate co-ingestion during endurance exercise

Combined ingestion of protein and carbohydrate improves protein balance during ultra-endurance exercise

Koopman *et al., Am. J. Physiol.*, 2004



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Preferred timing of protein ingestion

- before exercise

- during exercise

- immediately after exercise

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Window of opportunity

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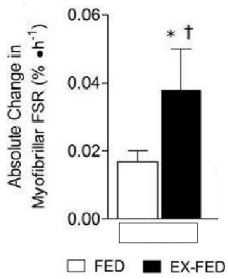
Muscle protein synthesis ŷ 24 h post exercise



Burd *et al., J Nutr,* 2011

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Window of opportunity

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Preferred timing of protein ingestion

- during overnight recovery

- subsequent day

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Can we augment post-exercise overnight recovery?

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Can we augment post-exercise overnight recovery?

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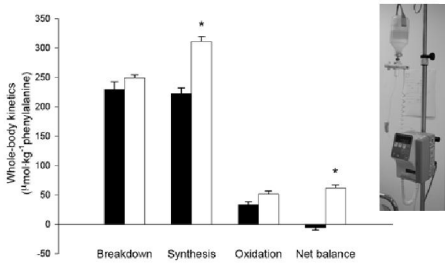
Protein balance during overnight recovery



Res *et al., Med. Sci. Sports. Exerc.*, 2012.

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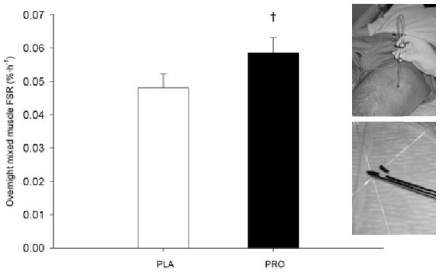
Overnight muscle protein synthesis rate



Res *et al., Med. Sci. Sports. Exerc.*, 2012.

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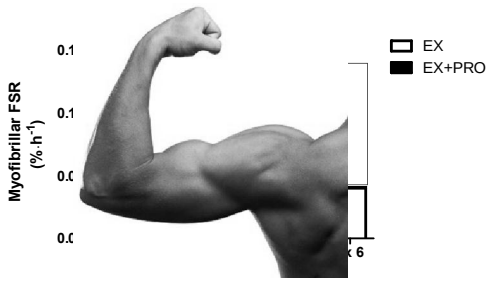
Does the acute response translate to improved anabolic adaptations to prolonged exercise training?



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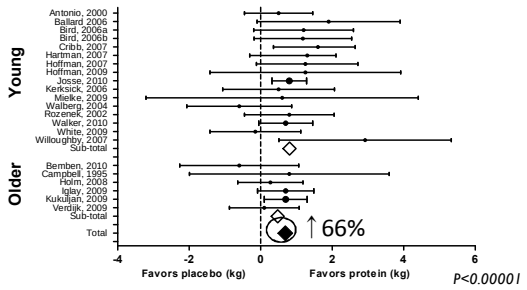
Protein supplementation augments the gain in FFM



Cermak *et al., Am J Clin Nutr, 2012 (in press)*

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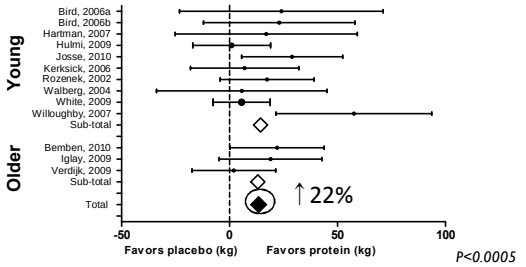
Protein supplementation augments the gain in strength



Cermak *et al., Am J Clin Nutr, 2012 (in press)*

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Protein ingestion plays a key role in muscle reconditioning

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What about whole milk as a protein source for muscle reconditioning?

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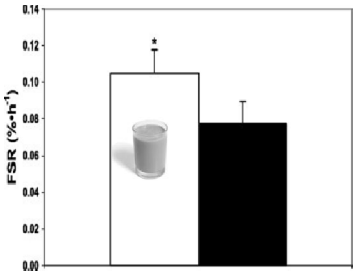
Chocolate milk ↑ muscle protein synthesis post exercise



Lunn et al. *Med Sic Sports Exerc*, 2012

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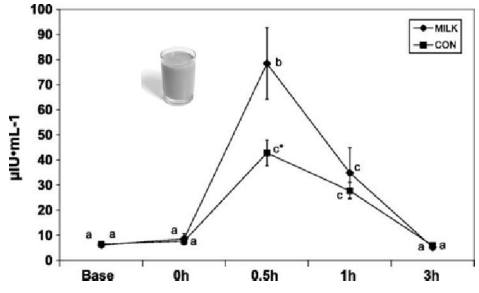
Chocolate milk ↑ insulin post exercise



Lunn et al. *Med Sic Sports Exerc*, 2012

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No difference in glycogen repletion

CON beverage:
1 g/kg CHO

Milk beverage:
0.8 g/kg CHO + 0.2 g/kg PRO

Similar glycogen repletion after 3h of recovery!

Lunn et al. *Med Sic Sports Exerc*, 2012

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Practical recommendations

- 20-25 g at each meal
- casein and whey represent good sources (or whole milk)
- consume protein immediately post exercise and prior to sleep
- add protein to carbohydrate for post race recovery
- add protein to carbohydrate drink during long training/racing bouts