Anabole resistentie bij veroudering

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Eindhoven, 7 Maart 2023

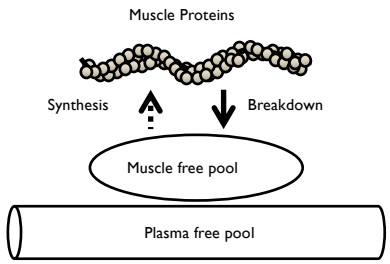
Universiteit van Nederland

https://www.youtube.com/watch?v=mCRzi1tObe0

University of the Netherlands

https://www.youtube.com/watch?v=huTlXfKHtVQ

Muscle protein turnover



Burd *et al., Exerc Sport Sci Rev*, 2013

Fractional muscle protein synthesis

1-2 % per day

(0.04 – 0.14 $\%\cdot h^{-1}$)

Muscle reconditioning

Lance Armstrong

Jay Cutler

Muscle deconditioning

- immobilisation
- sarcopenia
- cancer cachexia
- COPD
- type 2 diabetes
- cardiovascular disease

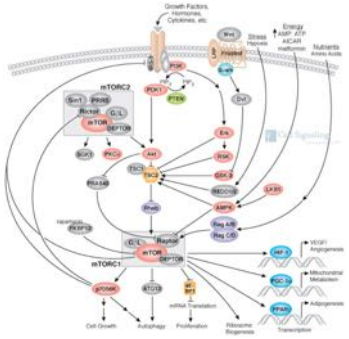
Muscle mass maintenance

Main anabolic stimuli

Nutrition is an anabolic stimulus

Amino acids

Amino acids stimulate protein synthesis



Post-prandial muscle protein synthesis

- protein digestion
- amino acid absorption
- plasma amino acid availability
- hormonal response
- postprandial perfusion
- muscle protein signaling proteins
- myofibrillar protein synthesis

Research methods

Post-prandial muscle protein synthesis

- protein digestion
- amino acid absorption
- plasma amino acid availability
- hormonal response
- postprandial perfusion
- muscle protein signaling proteins
- myofibrillar protein synthesis

Stable isotope tracers

Intrinsically labeled protein

van Loon *et al., J Dairy Sci*, 2009, Pennings *et al., J Dairy Sci*, 2010, Burd *et al., PLOS One*, 2013

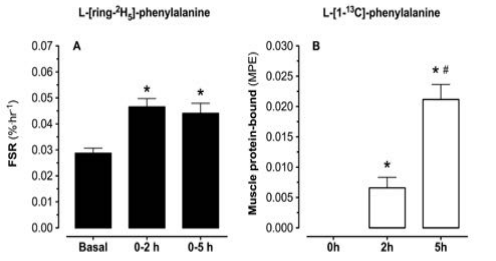
Post-prandial protein synthesis

Groen *et al., PLOS one, 2015*

Post-prandial protein synthesis

Groen *et al., PLOS one, 2015*

Post-prandial protein synthesis



Groen *et al., PLOS one, 2015*

'You are what you just ate'

Post-prandial protein synthesis


- source of protein


- amount of protein


- macronutrients

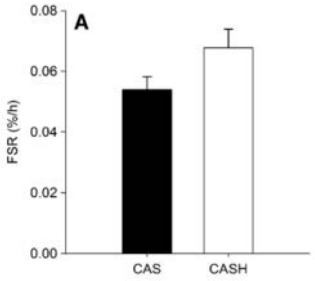

- timing


- food preparation


- body position

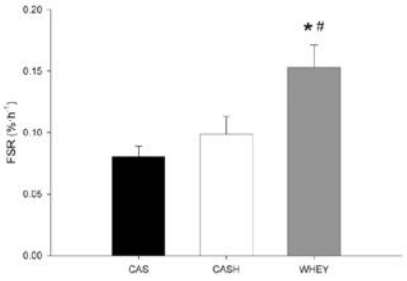
Source of protein

Intact protein versus protein hydrolysate



Koopman *et al., Am J Clin Nutr*, 2009

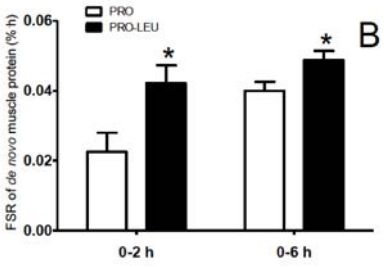
Whey versus casein



Pennings *et al., Am J Clin Nutr*, 2011

Whey versus casein

Leucine co-ingestion



Wall et al., Clin Nutrition, 2013

Milk versus Beef

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

Plant-derived proteins: game changers?

Plant based proteins

The Skeletal Muscle Anabolic Response to Plant- versus Animal-Based Protein Consumption[1]

Stephan van Vliet,[2,3] Nicholas A Burd,[2,3] and Luc JC van Loon[3]*

[2]Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Urbana, IL; and [3]Department of Human Movement Sciences, Faculty of Health, Medicine, and Life Sciences, School for Nutrition and Translational Research in Metabolism (NUTRIM), Maastricht University, Maastricht, Netherlands

van Vliet *et al., J Nutr,* 2015

Plant based proteins

van Vliet et al., J Nutr, 2015

Muscle gain on plant based protein consumption

Muscle gain on plant based protein consumption

Bill Pearl - 1971

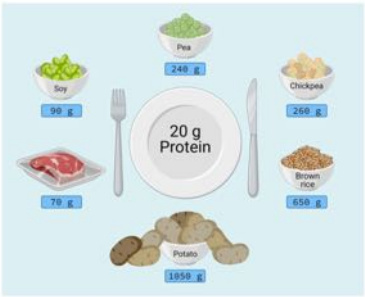
Soy

Tang et al., J Appl Physiol, 2009
Yang et al., Nutr Metab, 2012

Wheat

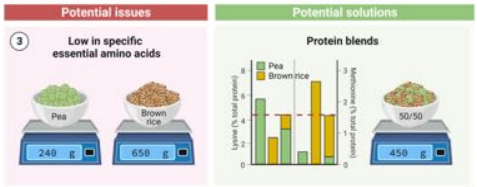
Gorissen et al., J Nutr, 2016

Plant-based whole-foods



Pinckaers *et al., Sports Med,* 2021

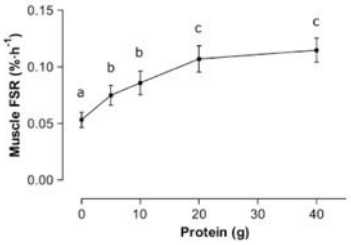
Anabolic properties of plant-based proteins



Pinckaers *et al., Sports Med,* 2021

Amount of dietary protein

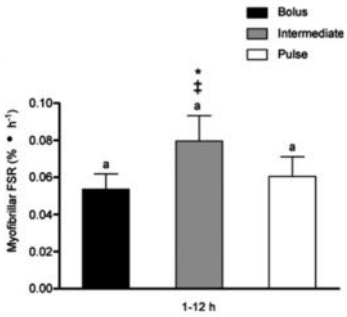
Amount of dietary protein



Moore et al., J.Physiol, 2009

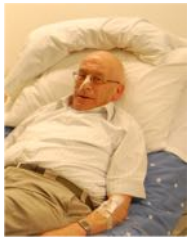
Timing of protein ingestion

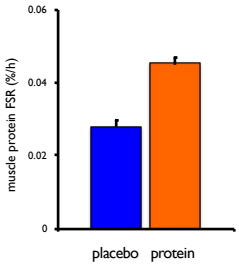
Protein intake distribution



Areta *et al., J Physiol*, 2013.

Muscle protein synthesis during sleep

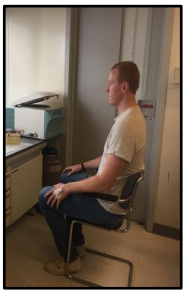




Groen *et al., Am J Physiol*, 2012

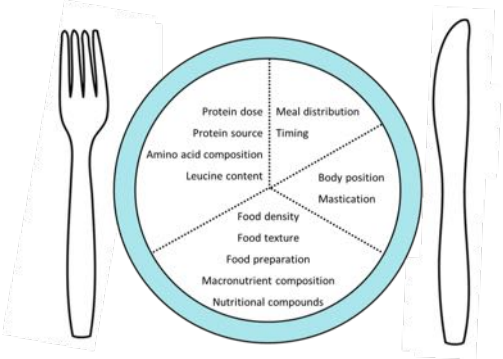
Food preparation

Body position



Whole foods and food processing

Post-prandial protein synthesis



Kouw *et al., PhD thesis, 2018.*

Muscle contraction is an anabolic stimulus

Muscle contraction

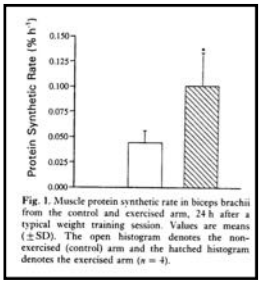
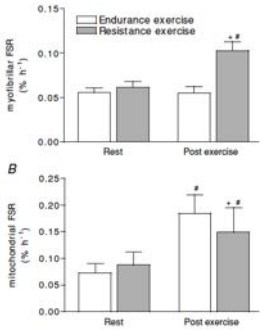


Fig. 1. Muscle protein synthetic rate in biceps brachii from the control and exercised arm, 24 h after a typical weight training session. Values are means (±SD). The open histogram denotes the non-exercised (control) arm and the hatched histogram denotes the exercised arm ($n = 4$).

Chesley *et al., J Appl Physiol, 1992.*

Post-exercise muscle protein synthesis



Wilkinson *et al., J Physiol, 2008.*

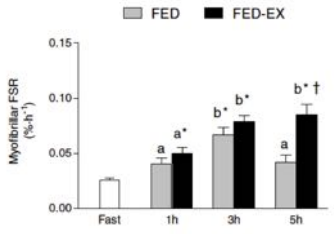
Muscle reconditioning

Lance Armstrong

Jay Cutler

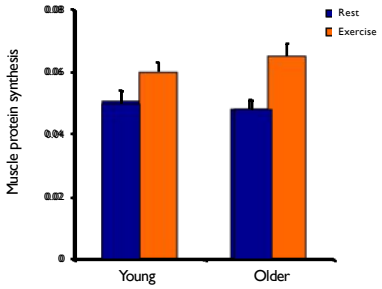
Synergy between exercise and food intake

Exercise and nutrition



Moore *et al., J Physiol*, 2009

Post-prandial muscle protein synthesis



Pennings *et al., Am J Clin Nutr*, 2010

Physical activity prior to food intake

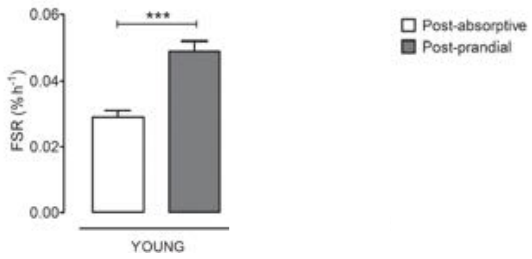
'You are more of what you just ate'

Muscle deconditioning

- sarcopenia
- cancer cachexia
- COPD
- type 2 diabetes
- cardiovascular disease

What causes muscle loss with aging

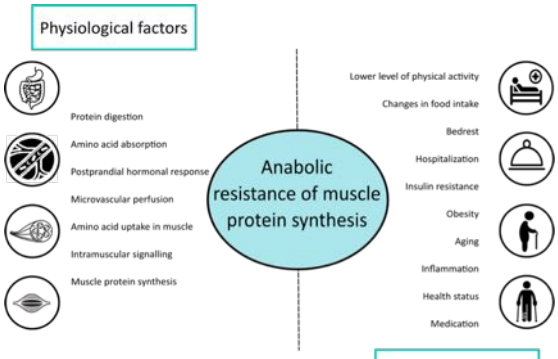
Anabolic resistance



Wall *et al., PLOS one, 2015*

Concept of anabolic resistance

Burd *et al., J Appl Physiol*, 2012



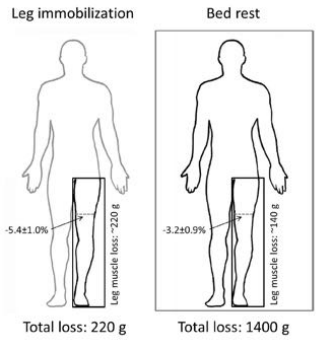
Decline in physical activity

Burd *et al., J Appl Physiol*, 2012

Muscle disuse

Wall *et al. Acta Physiol. Scand.*, 2013

Muscle deconditioning



Dirks et al. J Appl Physiol 2017

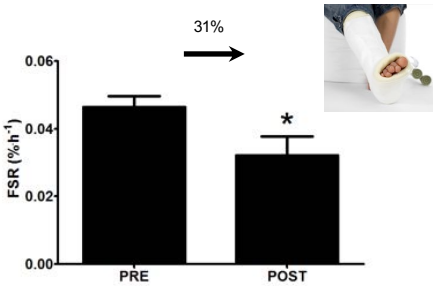
Marlou L. Dirks,[1] Benjamin T. Wall,[1] Bas van de Valk,[1] Tanya M. Holloway,[2] Graham P. Holloway,[2] Adrian Chabowski,[3] Gijs H. Goossens,[1] and Luc J.C. van Loon[1]

One Week of Bed Rest Leads to Substantial Muscle Atrophy and Induces Whole-Body Insulin Resistance in the Absence of Skeletal Muscle Lipid Accumulation

Diabetes 2016;65:2862–2875 | DOI: 10.2337/db15-1661

Dirks *et al. Diabetes*, 2016

Anabolic resistance to protein ingestion



Wall *et al. J Clin Endocrinol Metab*, 2013

Decline in physical activity

'You are less of what you just ate'

Clinical relevance

Exercise training in the elderly

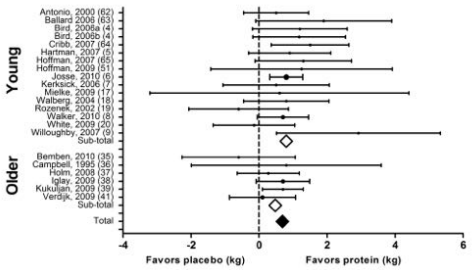
Muscle mass and strength

Endurance capacity

Functional capacity

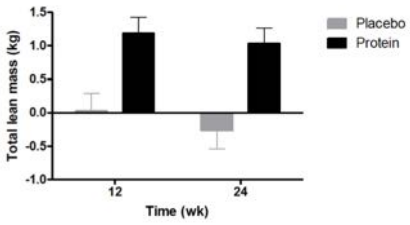
Frontera et al., 1988, 1990, 2003, Fiatarone et al., 1990, 1994, Charette et al., 1991, Lexell et al., 1995, Ades et al., 1996, Vincent et al., 2002, Bamman et al., 2003, Brose et al., 2003, Ferri et al., 2003, Roth et al., 2003, Short et al., 2003, 2004, Verdijk et al., 2009

Exercise training and protein supplementation



Cermak *et al., Am J Clin Nutr, 2012.*

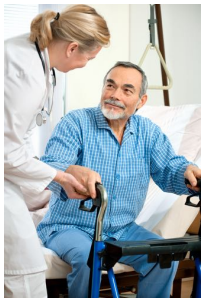
Protein supplementation in frail elderly



Tieland *et al., JAMDA, 2012-8*

Dirks *et al. Diabetes*, 2016

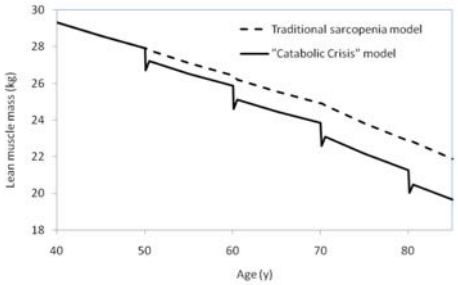
Hospital admission



Most older patients
are typically hospitalized
for 5-7 days

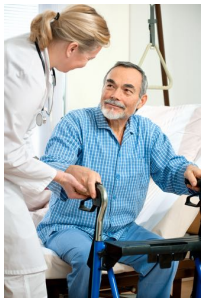
Fisher *et al, Arch Intern Med*, 2010

Catabolic crisis model



English *et al., Curr Opin Clin Nutr Metab Care, 2010*

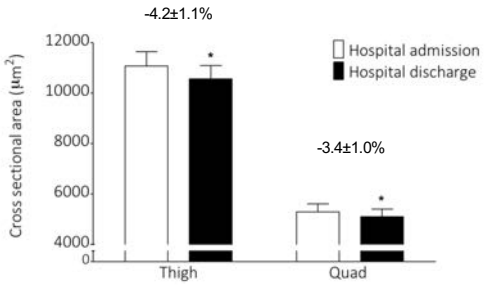
Hospital admission



Short periods of bedrest
following disease or injury
contribute substantially
to the loss of muscle mass
with aging

Wall *et al., Aging Res. Rev.*, 2013

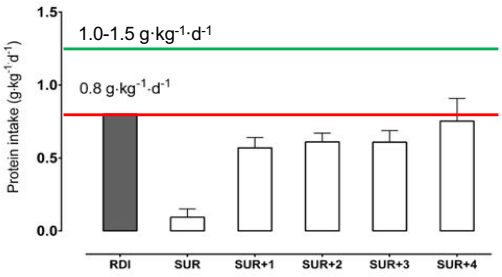
Muscle loss during hospitalisation



Kouw et al., JAMDA, 2018

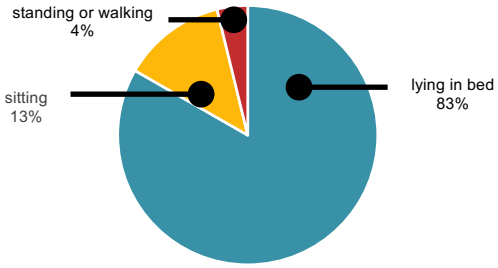
Attenuate muscle mass and/or strength loss

Protein intake during hospitalisation



Weijzen et al., J Nutr Health Aging, 2019

Physical activity during hospitalisation



Brown *et al, J Am Ger Soc*, 2009

Conclusions

Protein ingestion and muscle contraction stimulate muscle tissue protein synthesis

Physical (in)activity (de)sensitizes skeletal muscle tissue to the anabolic properties of dietary protein ingestion

Protein is required to support muscle conditioning in both health and disease

Attenuate muscle loss during disuse

- Remain physically active as much as possible
- Apply exercise mimetics when appropriate
- Consume a more protein dense diet
- Commit to an active rehabilitation program

Collaborators and sponsors