

Amino acid requirements for early-lactating dairy cattle

Amino acids, performance and health

24 September 2013, Ad van Vuuren



PhD proposal



■ University Campus Fryslân:

- Network University
- Co-operation
 - Universities of Applied Sciences: Stenden, NHL, Van Hall
 - Scientific Centres: Fryske Akademy, Wadden Academy
 - Universities: Wageningen, Delft, Twente, Groningen
- PhD programmes
 - Dairy Chain Friesland: + Nordwin College, Dairy Campus
 - Funding salary costs PhD candidate; **NOT** other project costs
 - Spring 2013: 74 proposals submitted and evaluated
 - Decision: mid-October 2013 (delayed)



Amino acid requirements in transition period



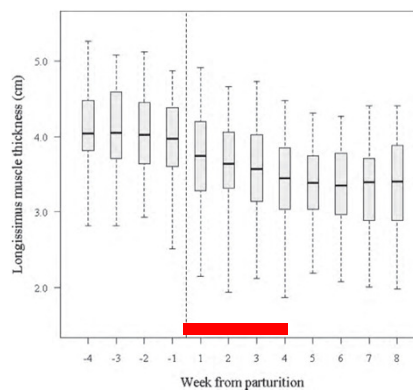
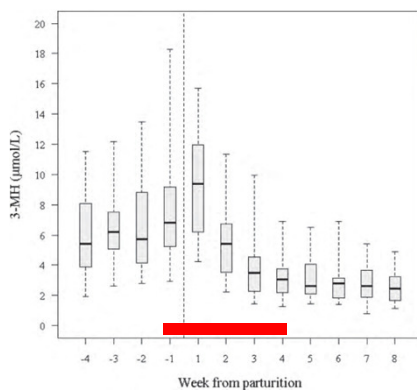
- Protein catabolism / anabolism
peripartum – early lactation – mid-lactation
- Interaction protein – fat metabolism
- Specific amino acid requirements
- Efficiency milk protein syntheses



Protein balance - *peripartum*



- Protein mobilisation: wk 1 *ap* until wk 4 *pp*



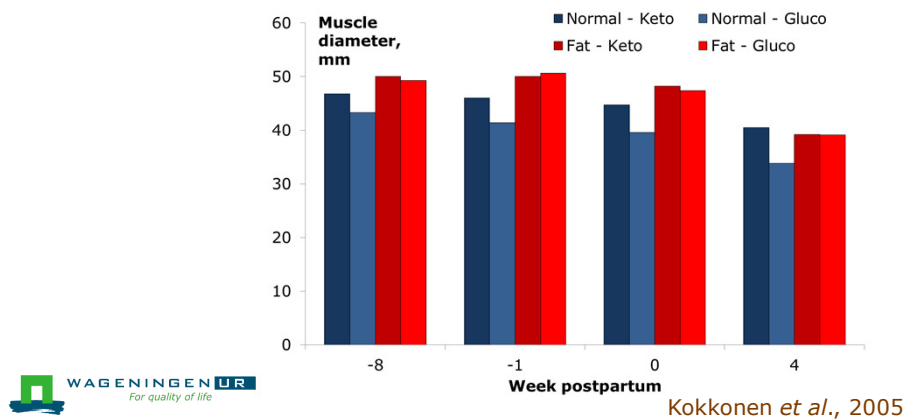
van der Drift *et al.*, 2012

Protein balance - *peripartum*



■ Protein mobilisation: wk 1 *ap* until wk 4 *pp*

● *Longiss. lumborum* diameter

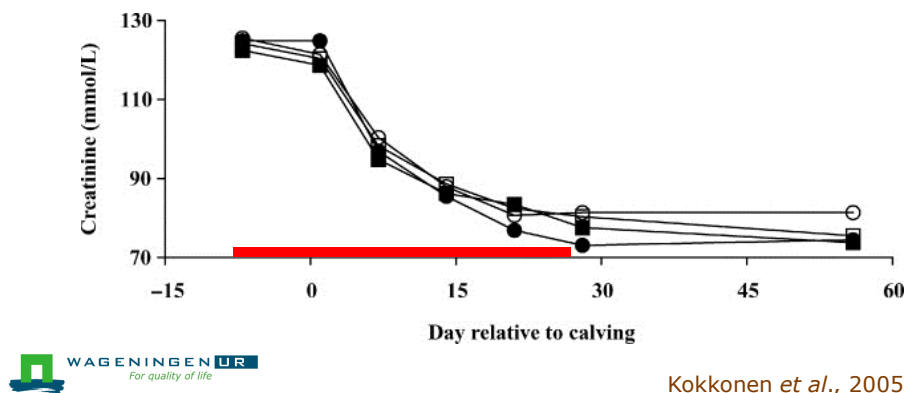


Protein balance - *peripartum*



■ Protein mobilisation: wk 1 *ap* until wk 4 *pp*

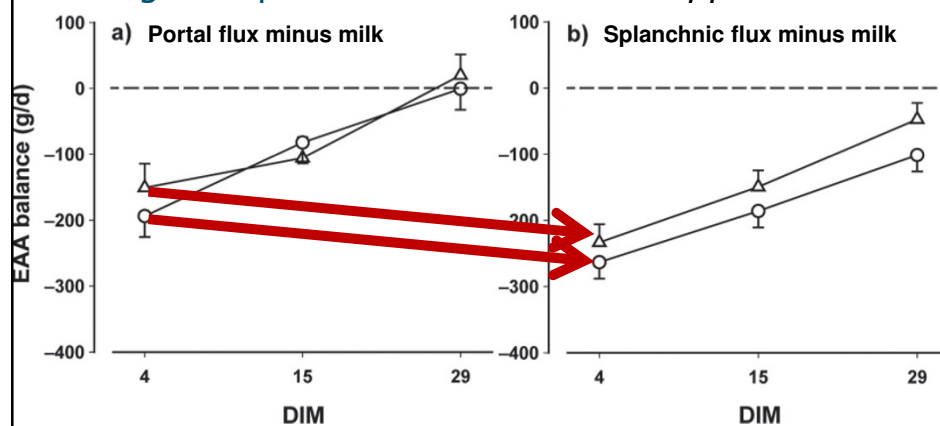
● Creatinine in plasma



Protein balance - *peripartum*



■ Negative protein balance: > wk 4 *pp*?



Dalbach *et al.*, 2011

Amino acids usage - *peripartum*



■ Milk protein synthesis

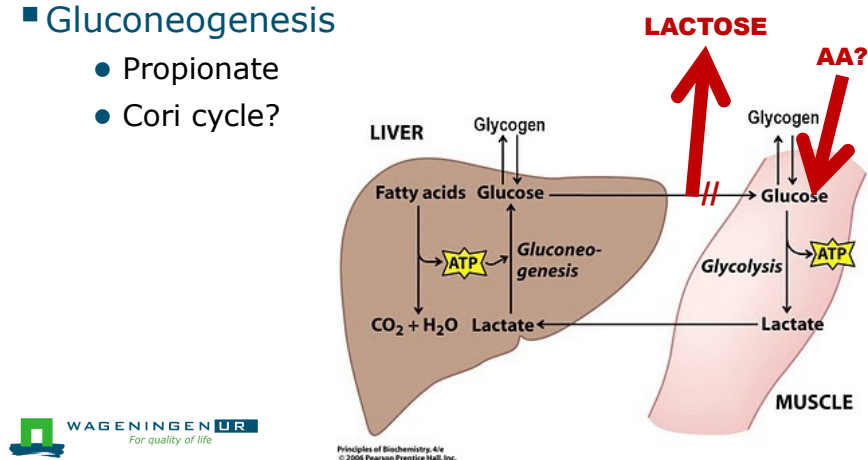


Amino acids usage - *peripartum*



- Milk protein synthesis
- Gluconeogenesis

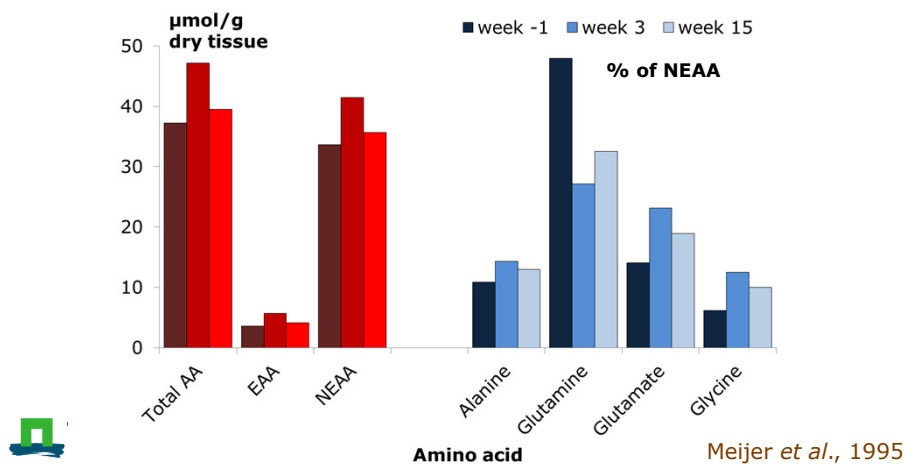
- Propionate
- Cori cycle?



Amino acid concentration in muscle



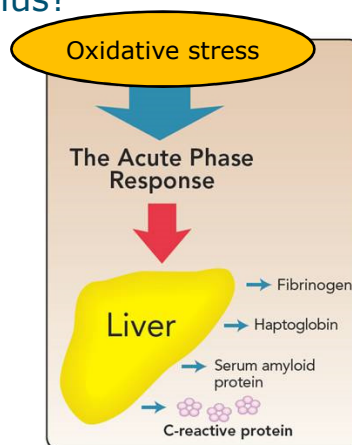
- Free AA in *Longissimus dorsi*



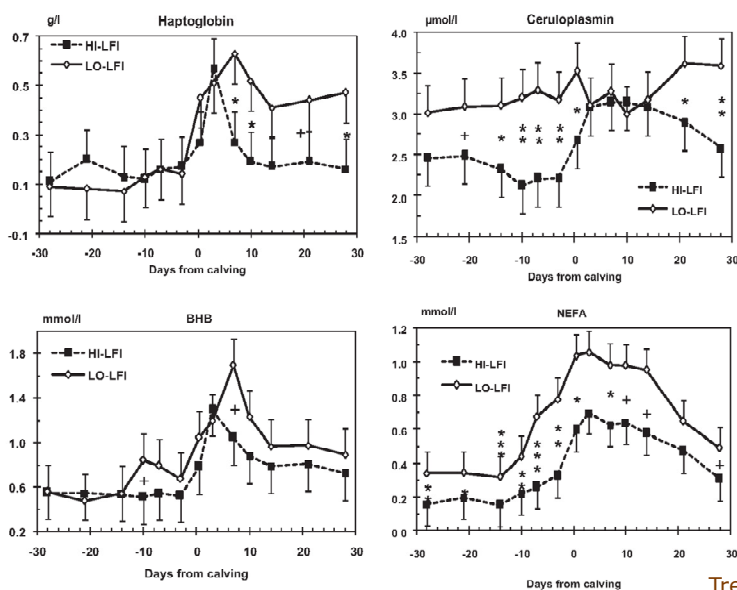
Amino acids usage - *peripartum*



- Milk protein synthesis
- Gluconeogenesis – Cori cyclus?
- Proliferation G.I.T.
- Acute phase proteins



Low LFI: high inflammatory response



Trevisi et al., 2012

Acute-phase proteins



- Protein requirements in stressed humans:
1 g/kg/day ~ maintenance requirements
- Relatively high in phenylalanine, tyrosine and tryptophan:
 - PHE: in acute phase proteins: 105 g/kg
in muscle: 40 g/kg



Plank, 2013

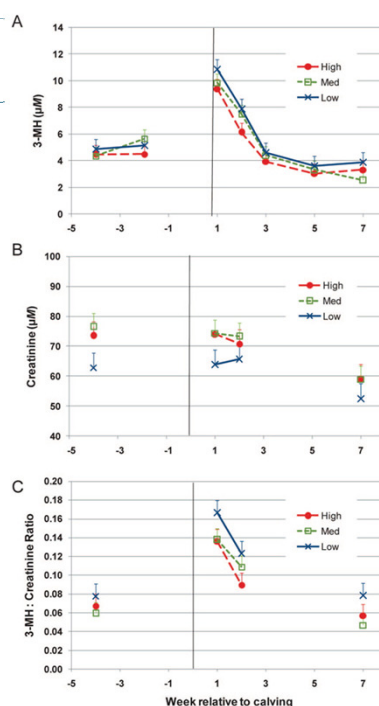
Interactions between fat and protein metabolism *peripartum*



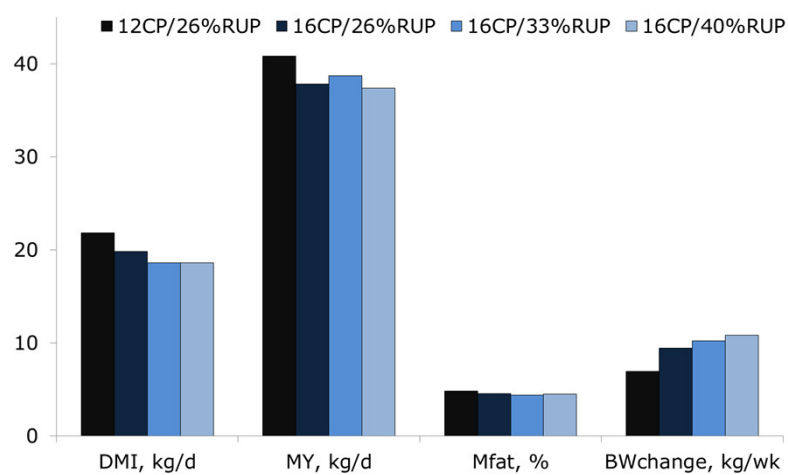
Interaction protein – fat

- Lean cows mobilise more muscle protein: higher 3-methylhistidine

Pires *et al.*, 2013



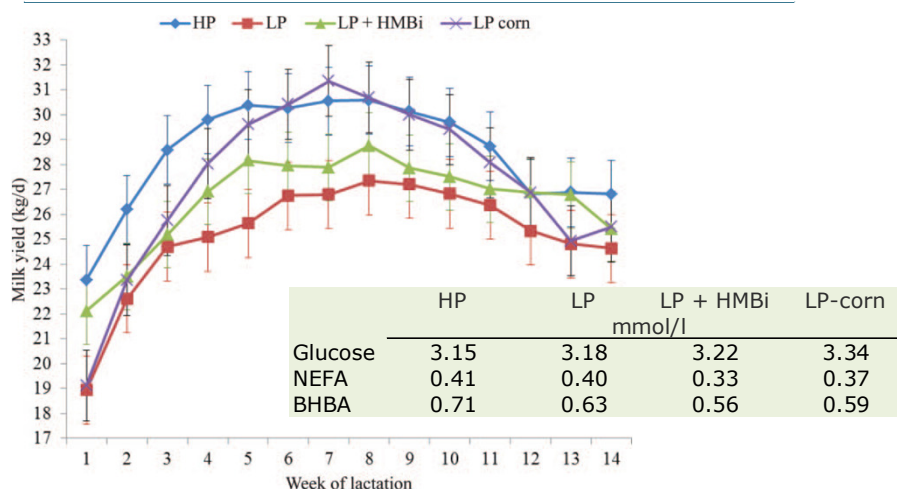
Interaction protein – fat metabolism?



Greenfield *et al.*, 2000

Interaction protein – fat

Low protein reduces NEB?



Whelan *et al.*, 2012

Manipulating energy and protein balance?



- Lower energy antepartum:
more protein mobilisation
- Lower protein postpartum:
less fat mobilisation



EAA supplementation



- Methionine 1st, lysine 2nd most limiting EAA (during *peripartum* period)?

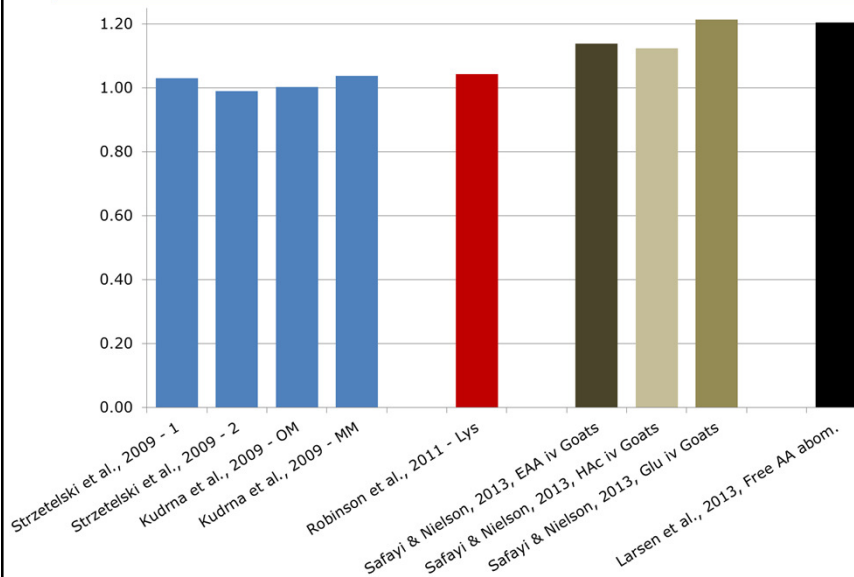
Met:

- Precursor Apo-lipoprotein B100
 - Methyl donor – saving choline?
- improving fat(ty acid) metabolism



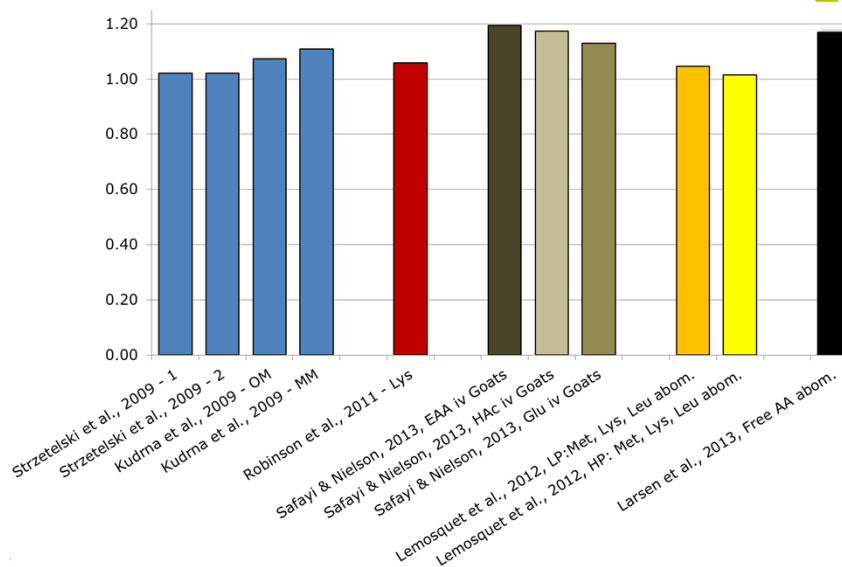
Effect AA supplementation on MY

Control = 1



Effect AA supplementation on MPY

Control = 1

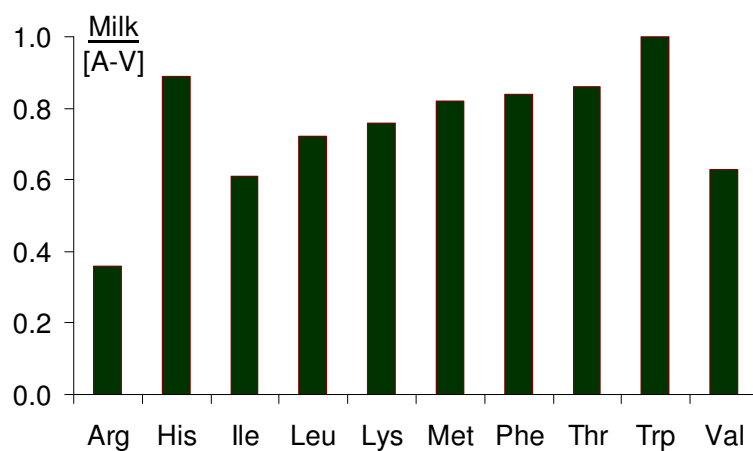


Efficiency milk protein production

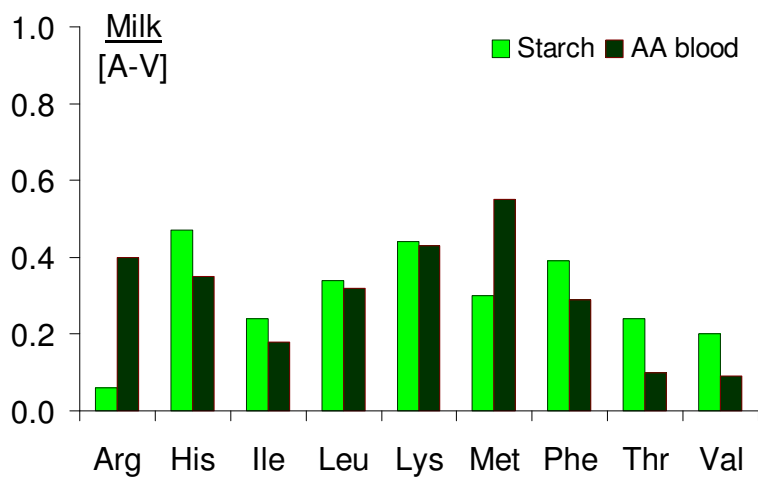


- Milk protein
 - / dietary crude protein
 - / metabolisable protein
 - / portal flux
 - / splanchnic flux
 - / mammary flux
 - / mammary A-V difference

Efficiency synthesis essential amino acids



Higher AA supply: lower efficiency



PhD project



■ Ideal amino acid profile?

- Metabolic stress – homeorhesis
 - energy/fat metabolism
 - protein mobilisation
 - feed (energy) intake
 - animal health and longevity
- Milk performance and milk quality
- Nitrogen excretion / N use efficiency



Approach



- Physiological studies – AA utilisation
- Performance studies

■ Collaboration:

- INRA – Rennes: Lemosquet
- University Reading / Dairyco: Reynolds
- Virginia Tech: Mike Hanigan
- Cath. University Piacenza: Trevisi
- WU FQD: Valenberg



Project team



- PhD candidate: ...
- Supervisors:
 - Wouter Hendriks, WU
 - Jan Dijkstra, WU
 - Ad van Vuuren, WLR
- Industry
 - Bertho Boswerger, ForFarmers
 - Jacob Goelema, De Heus
 - Harmen van Laar, Nutreco
 - Eddy Weurding, Agrifirm



Amino acid requirements for early-lactating dairy cattle



Time schedule?

- October 2013: Financial support Fryslân
- October 2013: Approval UCF panel
- Winter '13/'14: Selection candidate
- Spring '14: Project description
 - Approach
 - Time schedule
 - Planning collaboration
- Summer '14: start



