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Exogenous phytase for dairy cows

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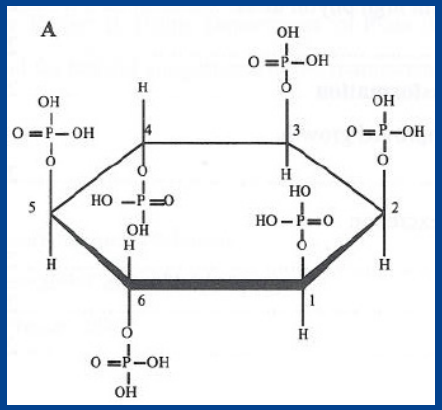
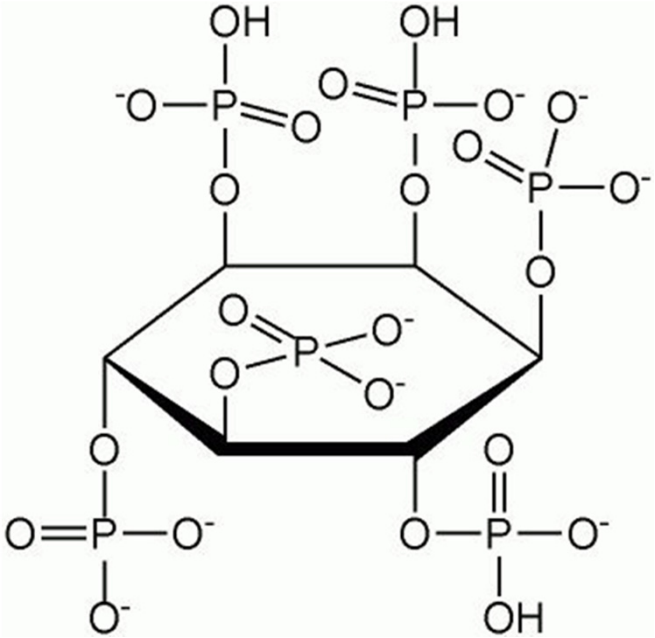
Novozymes A/S, R&D



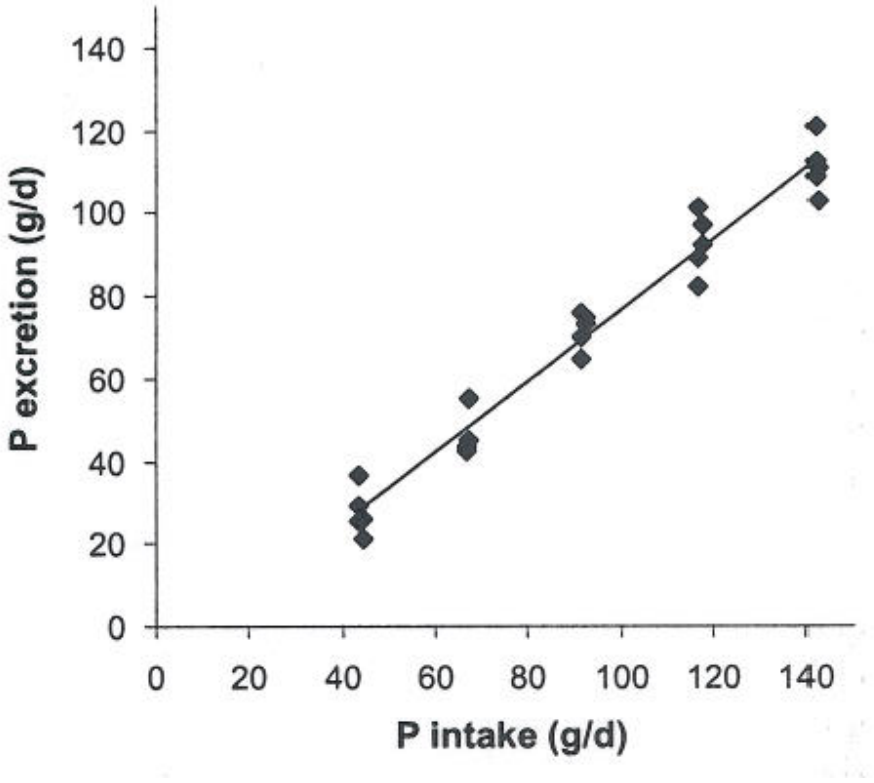
Ruminal degradation of phytate is incomplete

Phytate



- Storage of P in grains and in protein seeds like soja and rape
- Heat and formaldehyde reduce ruminal degradation
  Park et al. 1999; Konishi et al. 1999
- Exogenous phytase increase digestibility and reduce excretion of P
  Kincaid et al. 2005; Knowlton et al. 2007

Low P availability -> high excretion



Ekelund et al. Livestock Prod. Sci., 2005

Type of phytase to use for dairy cows

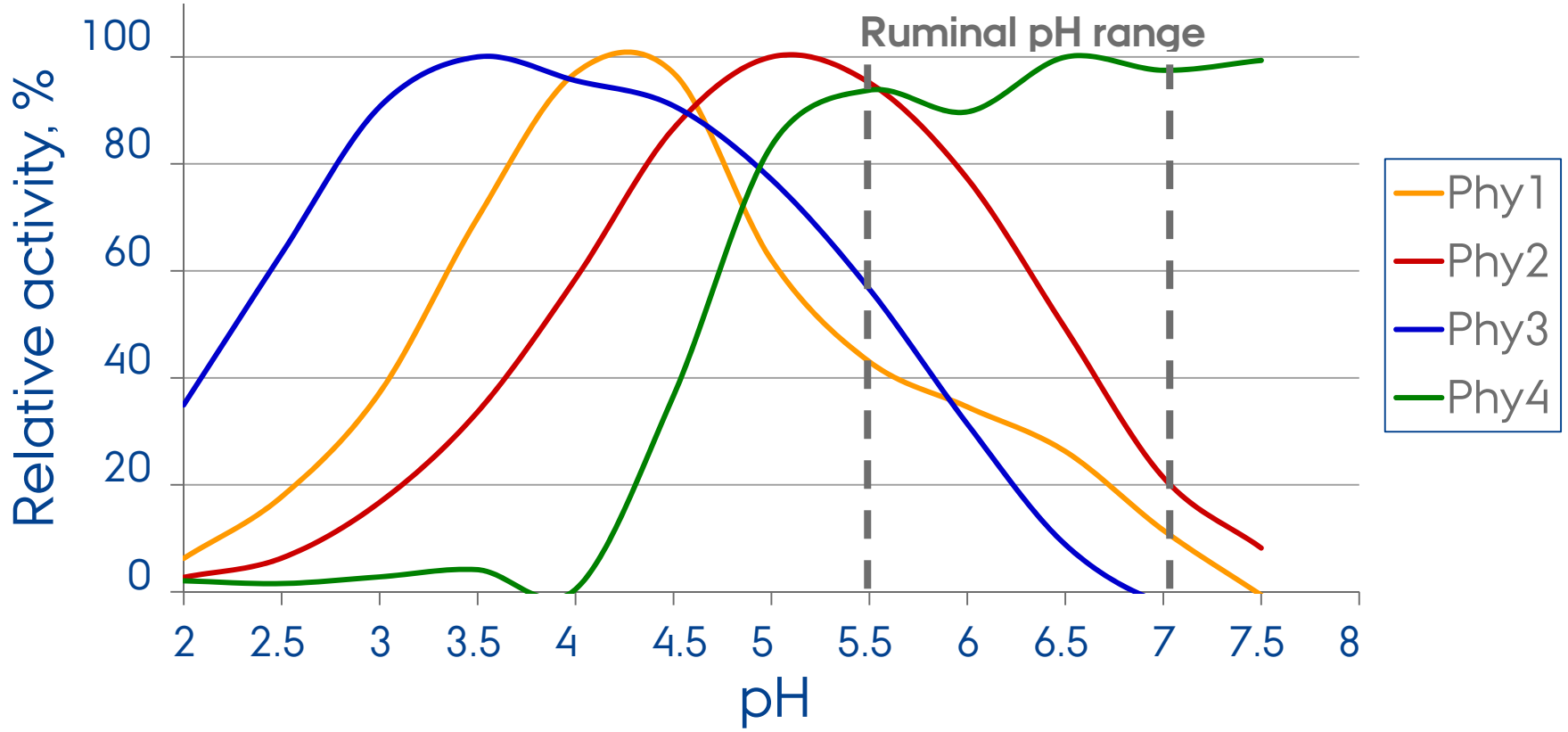
- Available phytases are developed for pigs and poultry
- Which phytase type to use?
- How to apply it?
- How much to apply?

Test of phytases in an *in vitro* rumen fluid buffer system

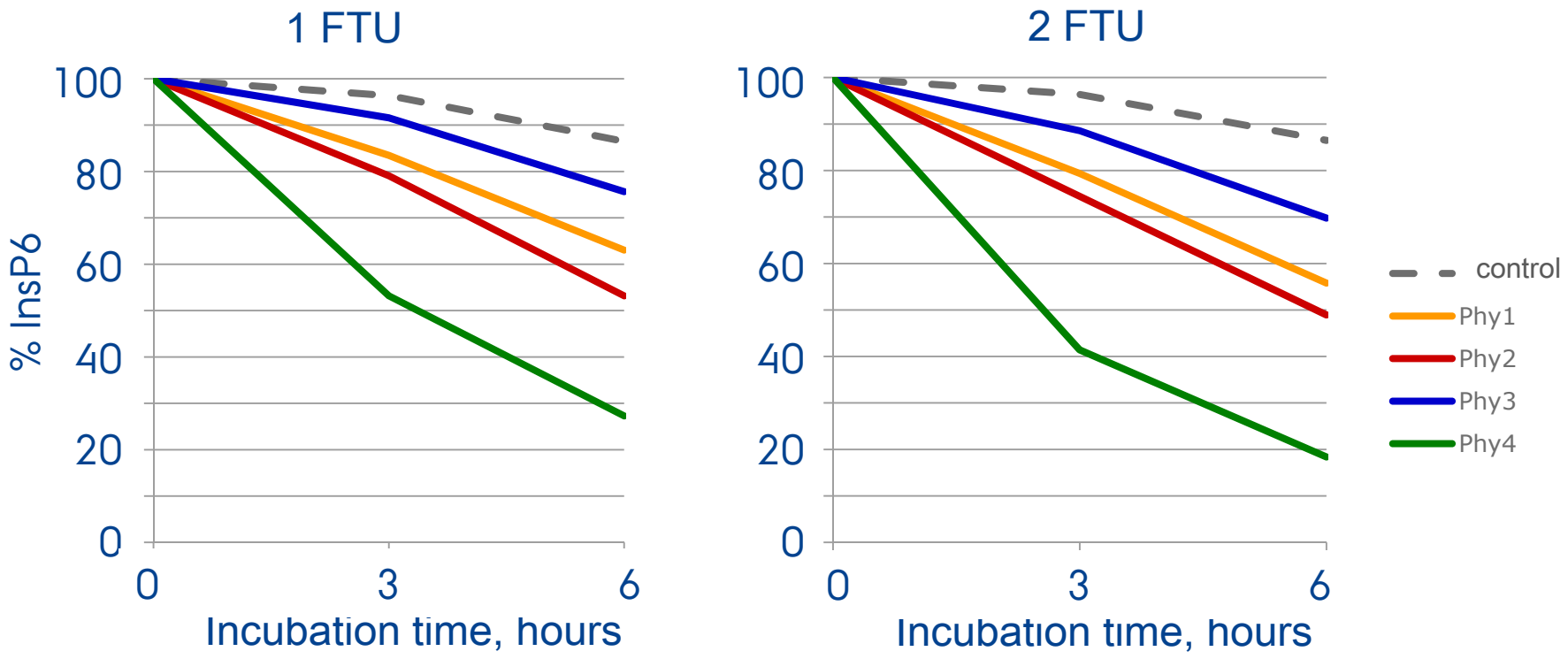
- Four experimental phytases (mikrobial)
  - Phy1, Phy 2, Phy3: histidine acid phosphatase phytases
  - Phy 4: β-propeller phytase
- Modified Tilley and Terry (1963) method:
  - Feed + phytase incubated with ruminal fluid and buffer

Brask-Pedersen et al. 2011, J. Dairy Sci.

Relative activity at 37 °C
Na-phytate as substrate

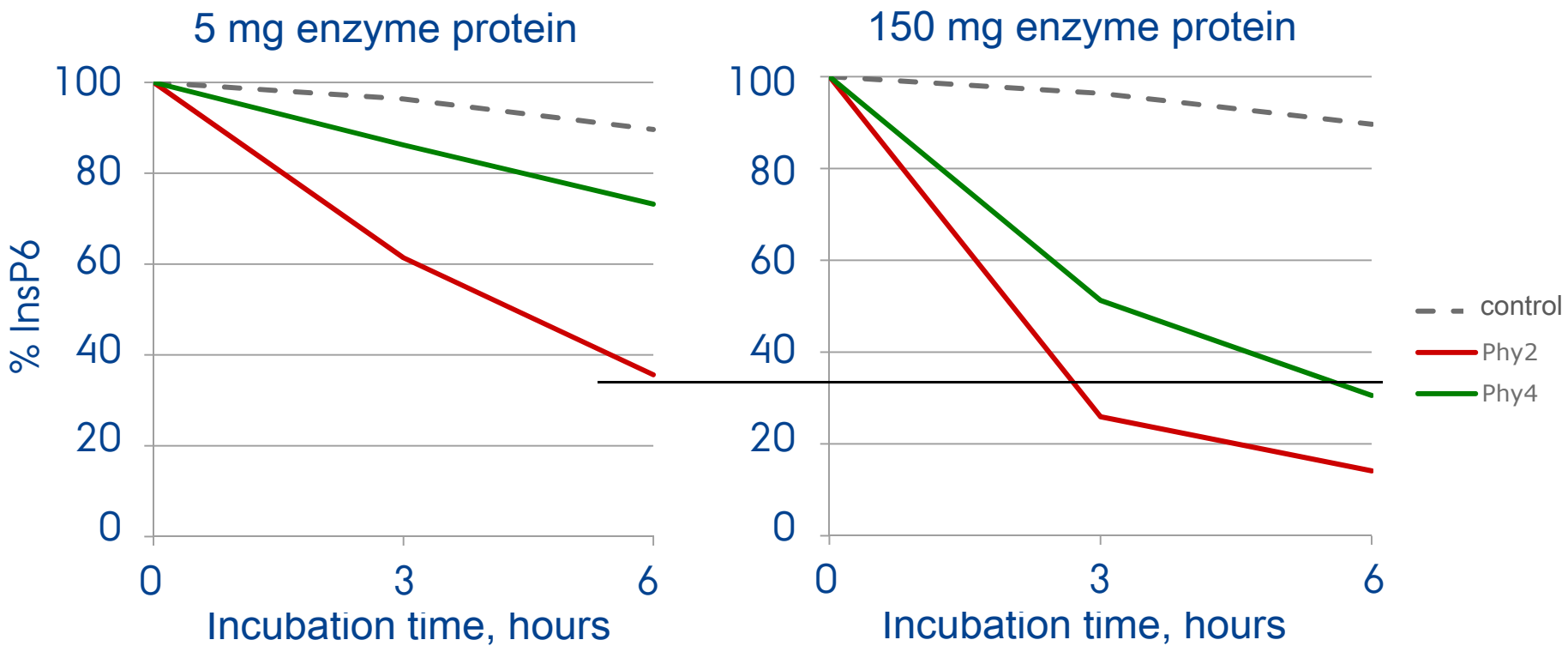


1 and 2 FTU per g of rapeseed cake



Brask-Pedersen et al. 2011, J. Dairy Sci.

Amount of enzyme protein per g feed



Brask-Pedersen et al. 2011, J. Dairy Sci.

Sum up on *in vitro* experiment

- Exogenous phytase increased degradation of phytate in rapeseed cake
- Phy4 and Phy2 was most effective
- Phy2 had the highest specific activitet
- Phy2 was choosen for in vivo experiment

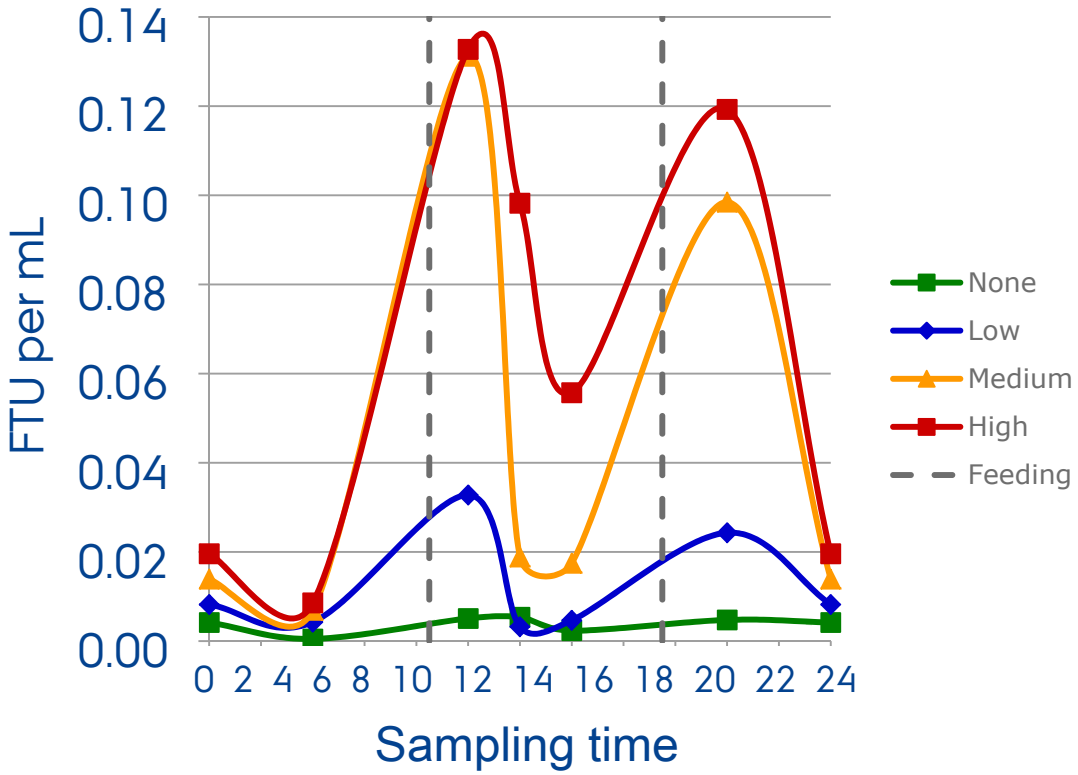
Brask-Pedersen et al. 2011, J. Dairy Sci.

Test of Phy2 in fistulated dairy cows

- 4 fistulated Holstein dairy cows in 4 x 4 latin square design
- 3-week periods: two weeks adaptation, one week sampling
- Phytase in TMR :
  - None, low, medium or high
  - 23, 2023, 3982, 6015 FTU/kg DM
- Chromic oxide as flow marker

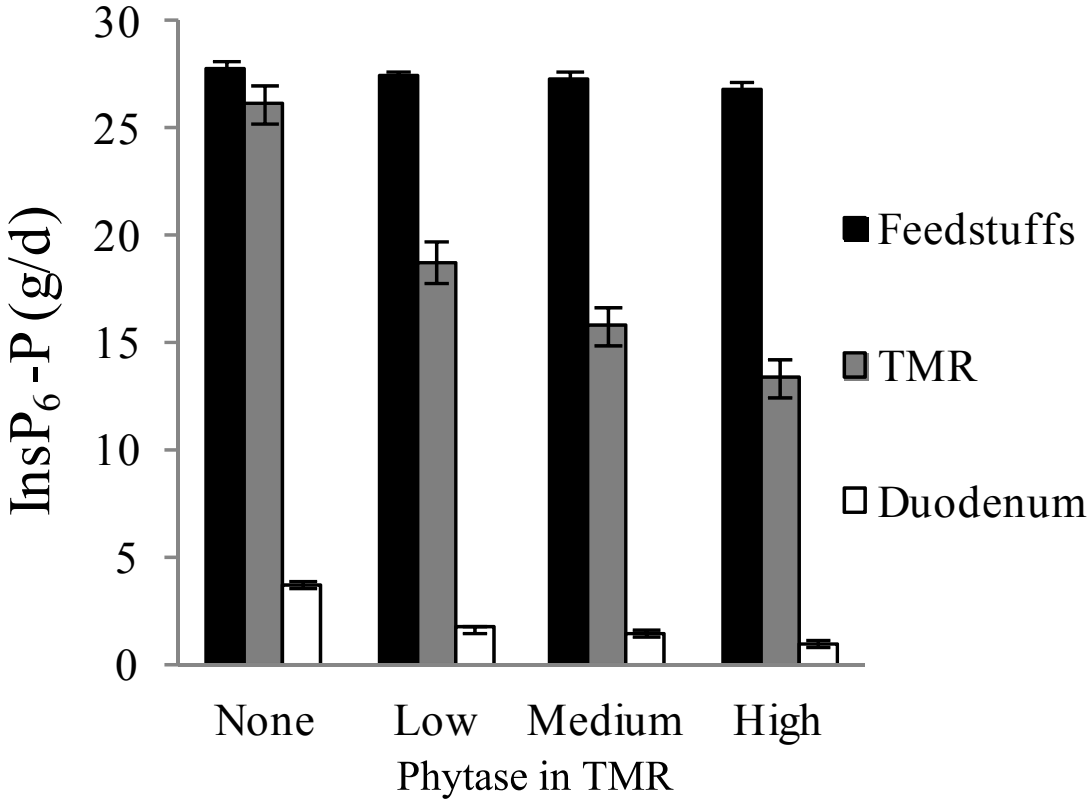
Brask-Pedersen et al. 2013, J. Dairy Sci.

Ruminal phytase activity



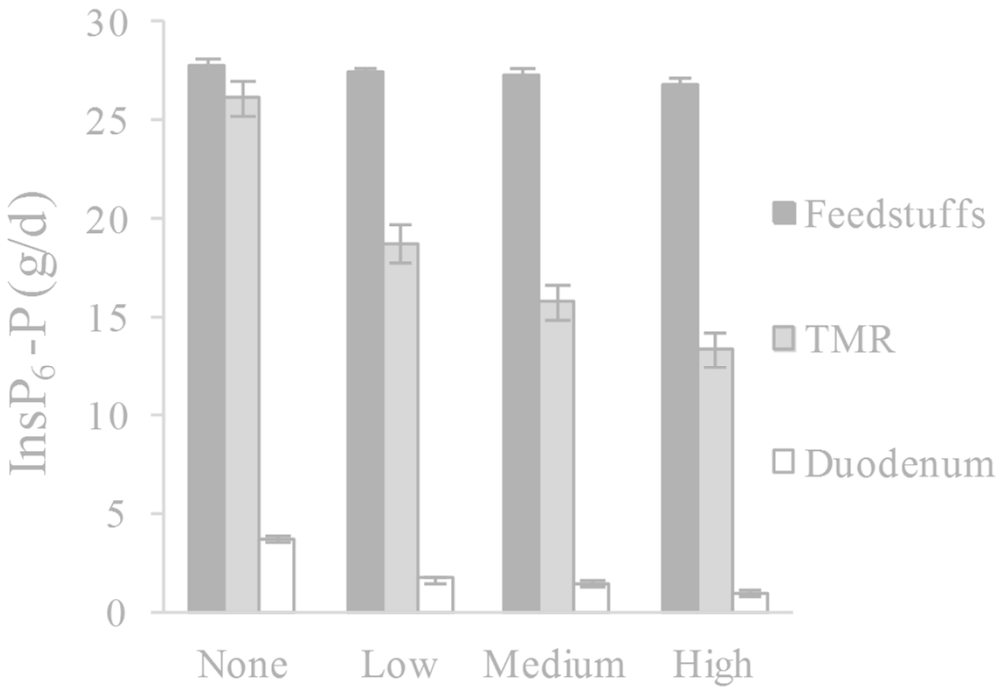
Brask-Pedersen et al. 2013, J. Dairy Sci.

Phytate flow from feed to duodenum



Brask-Pedersen et al. 2013, J. Dairy Sci.

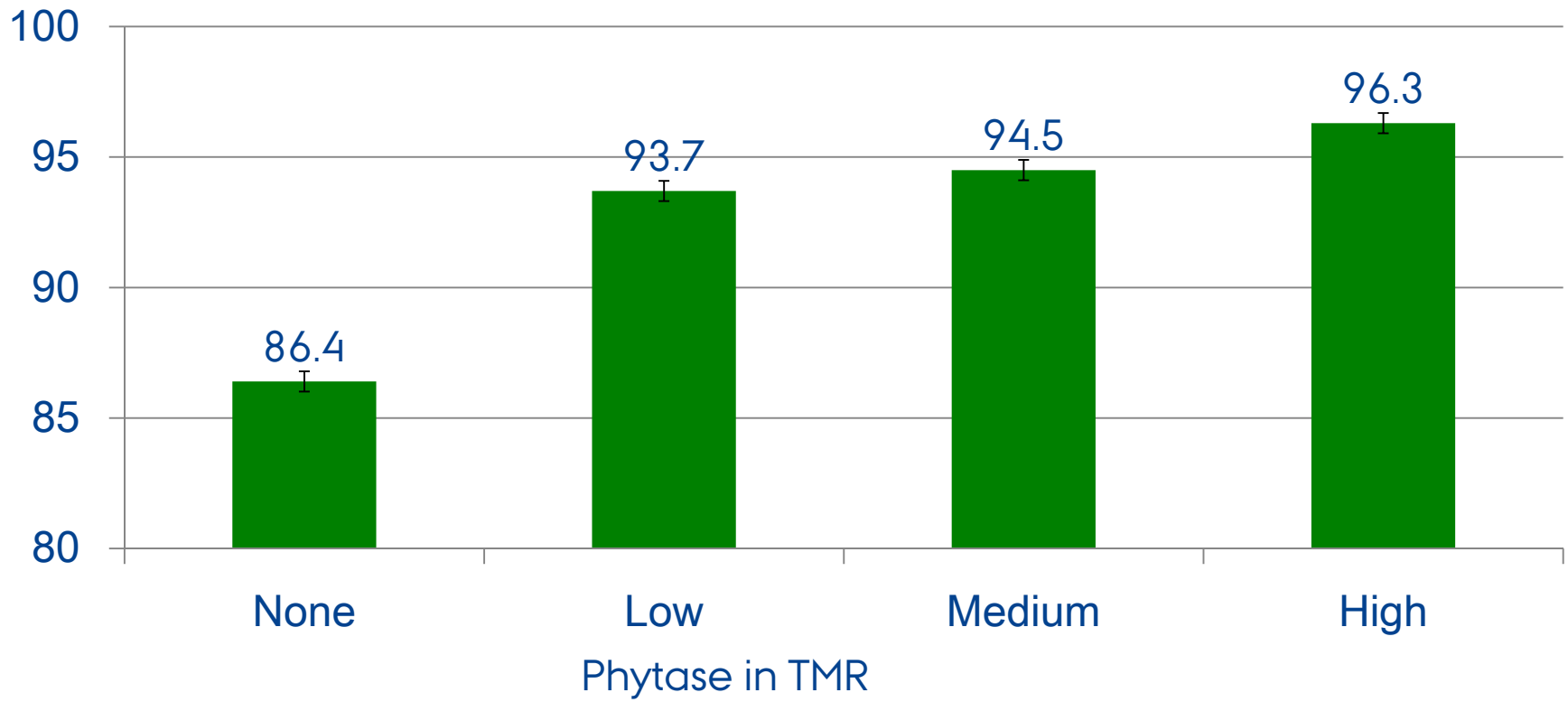
Phytate flow from feed to duodenum



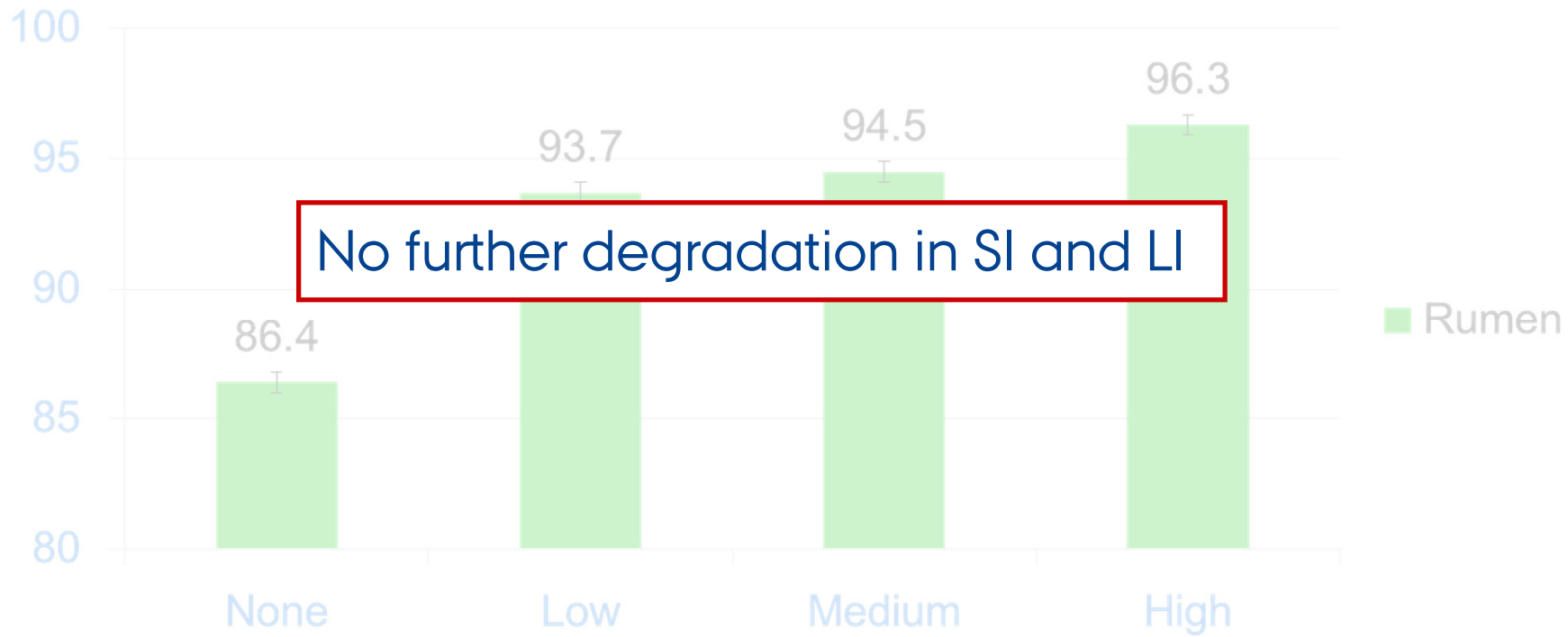
Degradation in two steps:

- In the TMR
- In the rumen

Degradation of phytate in the rumen



Degradation of phytate in the rumen

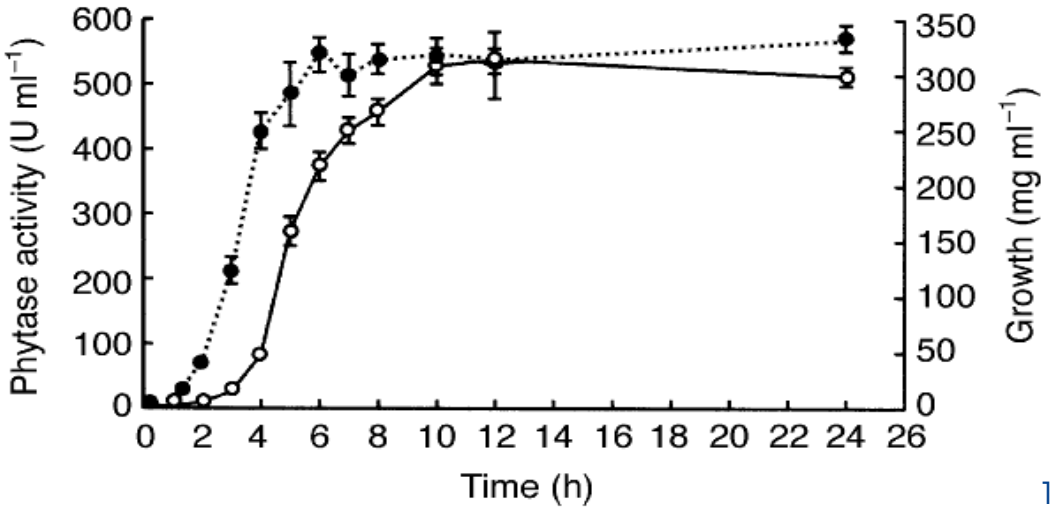


Sum up on *in vivo* experiment 1

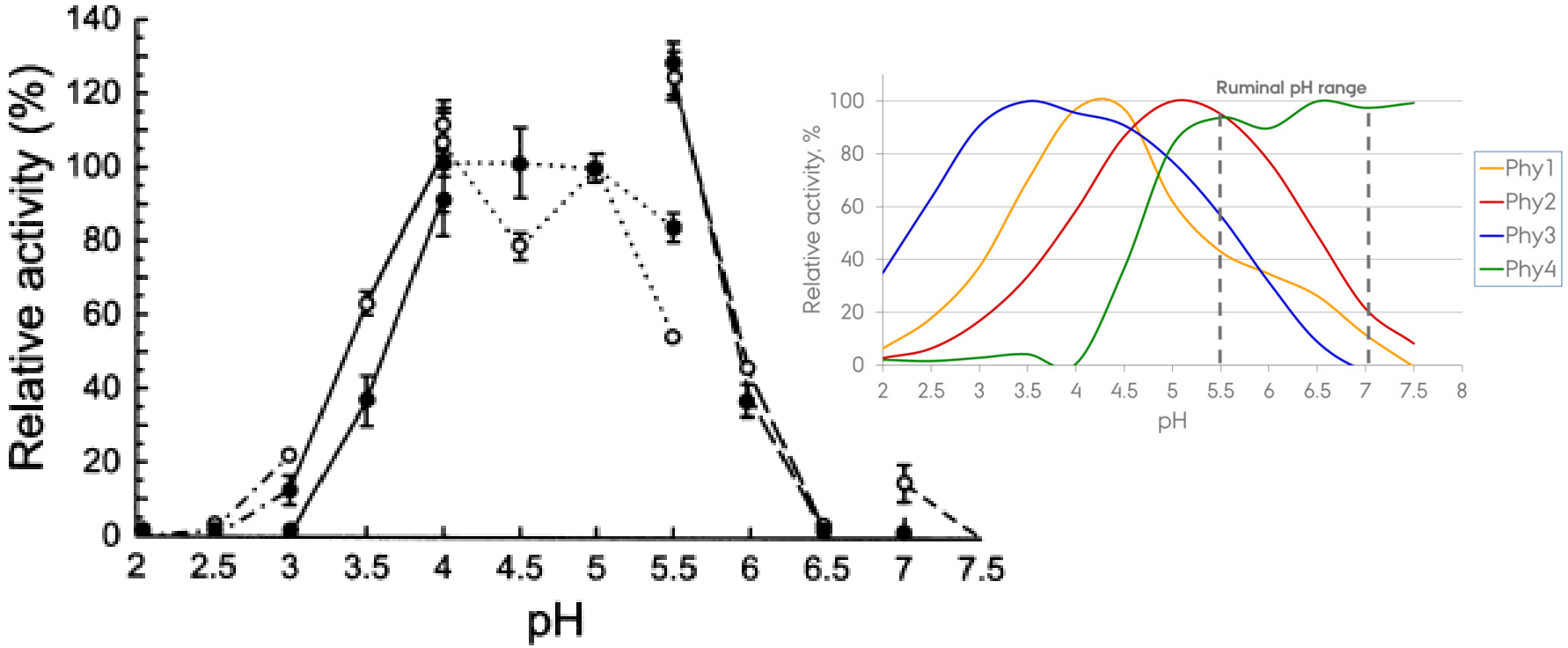
- Exogenous phytase increased ruminal phytase activity
- Rumen and total-tract degradation of phytate were increased with dose of exogenous phytase
- Low marginal effect of increasing dose of phytase
- Phytate degradation started in TMR when exogenous phytase was applied
- Ruminal pH and digestibility of NDF was not affected

Microbial phytase activity in the rumen

- *Selenomonas ruminantium*:
  - Primary producer of ruminal phytase
  - Cell-associated activity of phytase
  - Stimulated by starch
    (Yanke et al. 1998 & 1999)



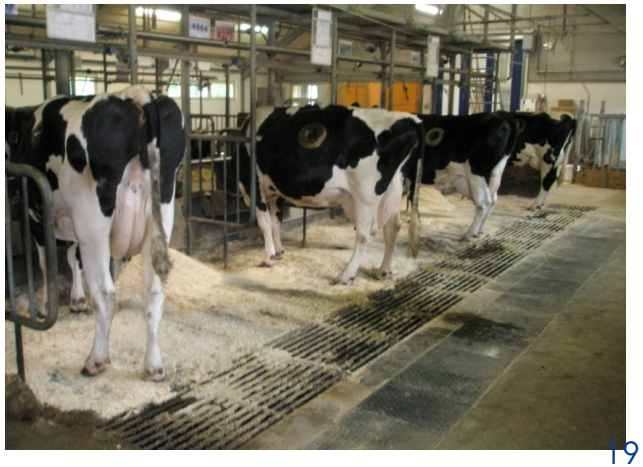
Selenomonas ruminantium phytase



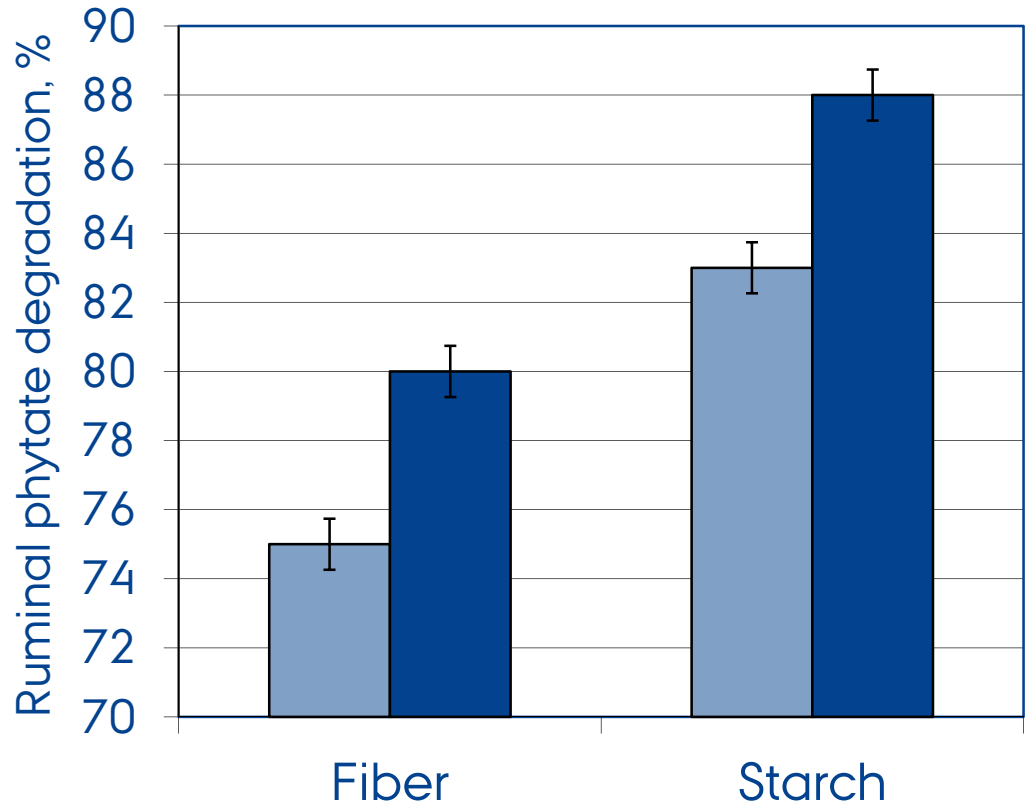
(Yanke et al. 1999)

Test of interaction between exogenous phytase and ruminal phytase activity

- 4 fistulated Holstein dairy cows in 4 x 4 latin square design
- 3-week periods: two weeks adaptation, one week sampling
- Dietary treatments:
  - Starch (corn meal) vs Fiber (soyhulls)
  - No phytase vs 3590 FTU/kg DM



No interaction between exogenous phytase and ruminal phytase activity



Treatment	P-value
CHO (78 vs. 86%)	<0.001
Phytase (79 vs. 84%)	0.005
CHO x Phytase	1

Conclusion

- Ruminal phytate degradation was increased by dietary starch and by exogenous phytase
- Phytate degradation started in TMR when exogenous phytase was applied
- Phytate degradation was improved by 10 ->13 %-units