

# Nutritional strategies to minimize carbon footprint and maximize nitrogen efficiency in dairy systems



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Building a Resilient Dairy Sector – Circular Economies of Dairy Production and Dairy Foods



# Outline

- Danish dairy production
- Farm trials focusing on higher N-efficiency
- Phase feeding of protein at Reading University
- Farm trials focusing on Bovaer to decrease carbon foot print of milk



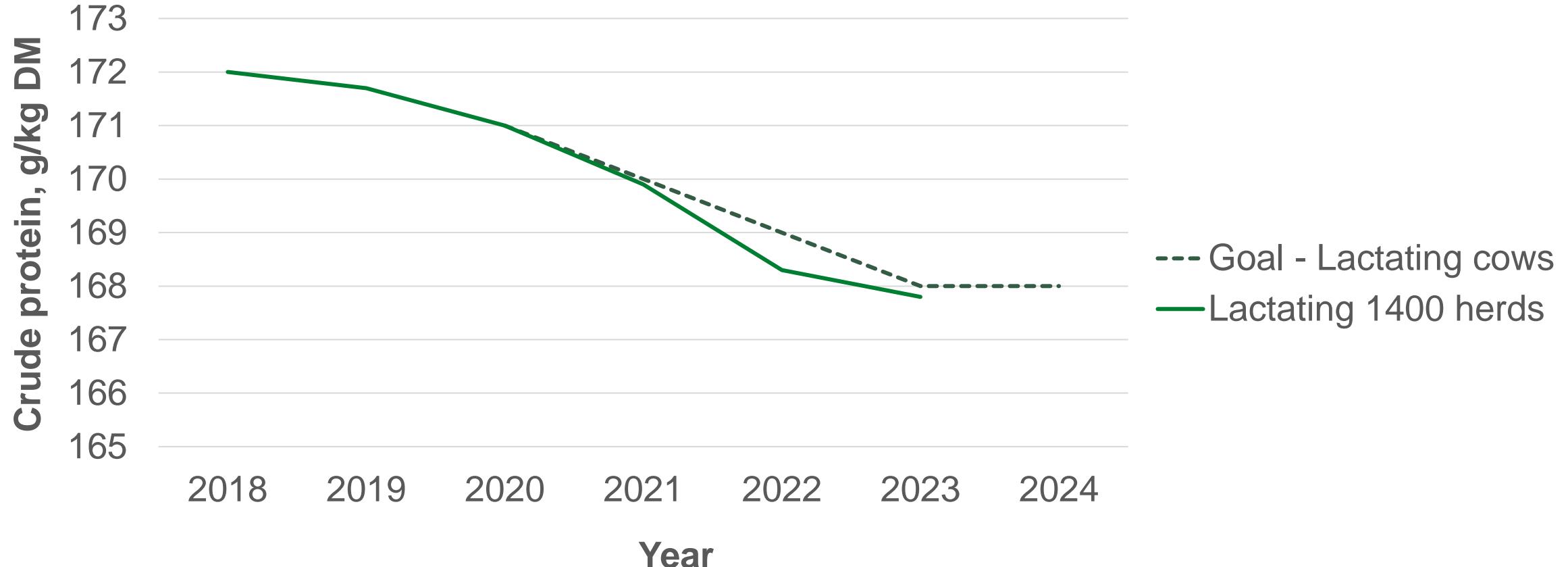
# SEGES Innovation is private, non profit and independent R&D within Agriculture



- Farmers
- Advisory service
- Companies
- Universities

# Ammonia emission is regulated in the EU

Law on protein level in diets vs voluntary agreement for Danish dairy farmers



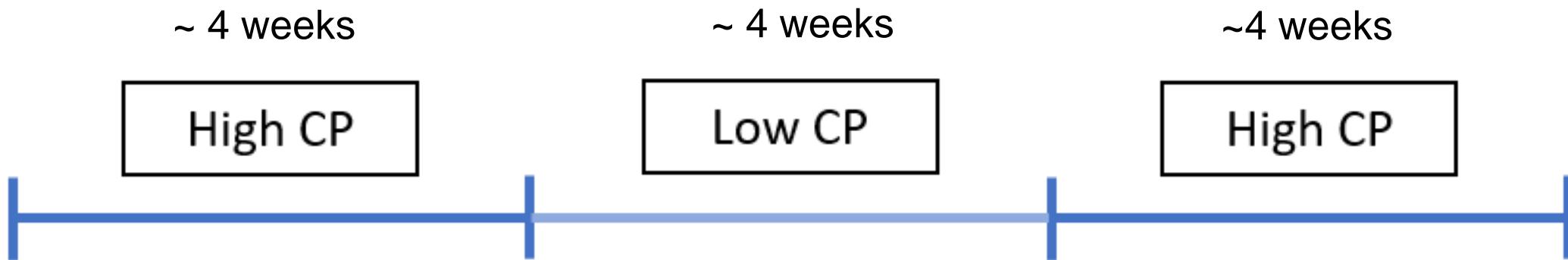
# CP-level (g/kg DM) from dairy farms (Lactating cows, 2022)

	10%	25%	Median	75%	90%
<b>Jersey, n=181</b>	161	165	170	175	180
<b>Large breed, n=1232</b>	158	164	168	172	176

# Trials in 11 dairy herds – crossover design

Aim:

- Reduce crude protein in the diet
- Increase N-efficiency
- Reduce Ammonia emission
- Increase IOFC



# Data collection

## Cow data



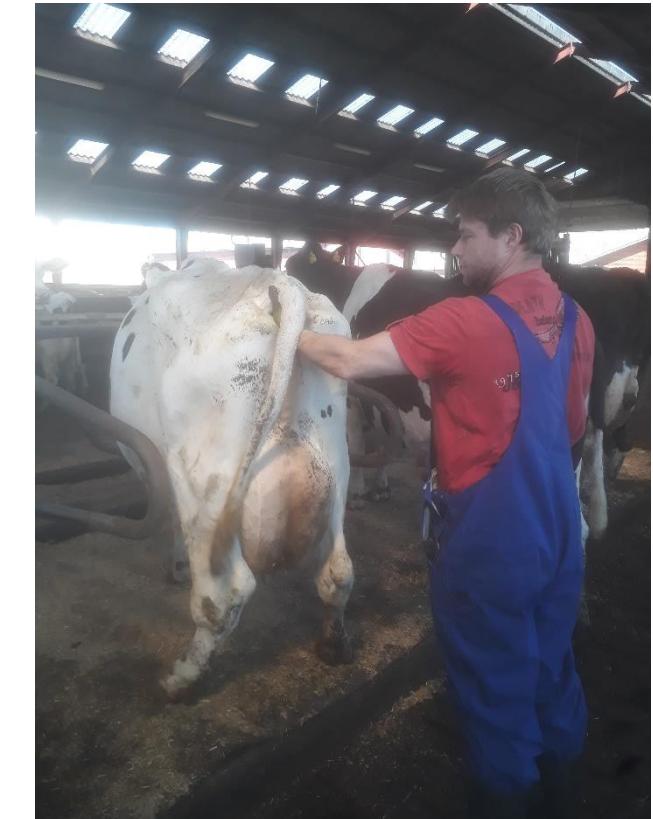
## Bulk milk & individual milk recordings



## Feed



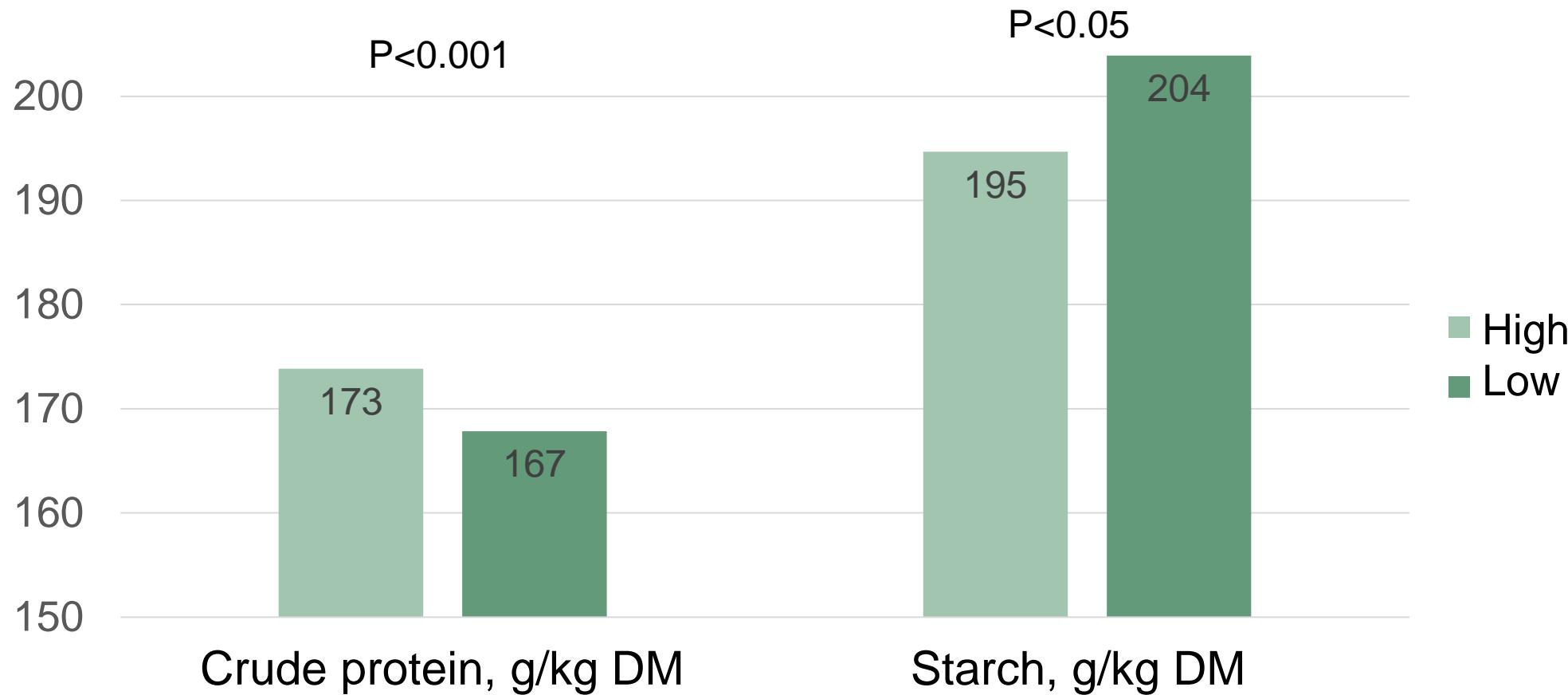
## Feces



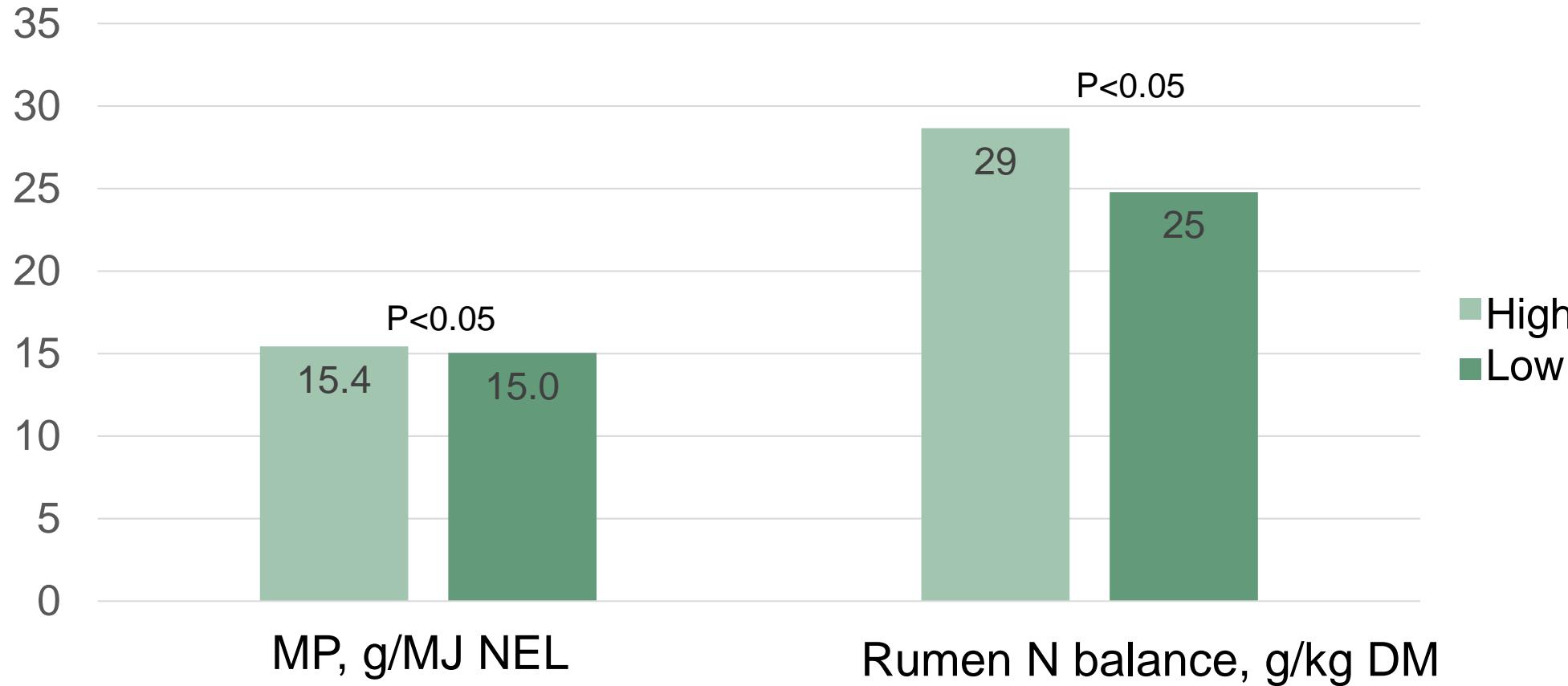


# Results – Nutrients

# Crude protein and starch



# MP and rumen N balance



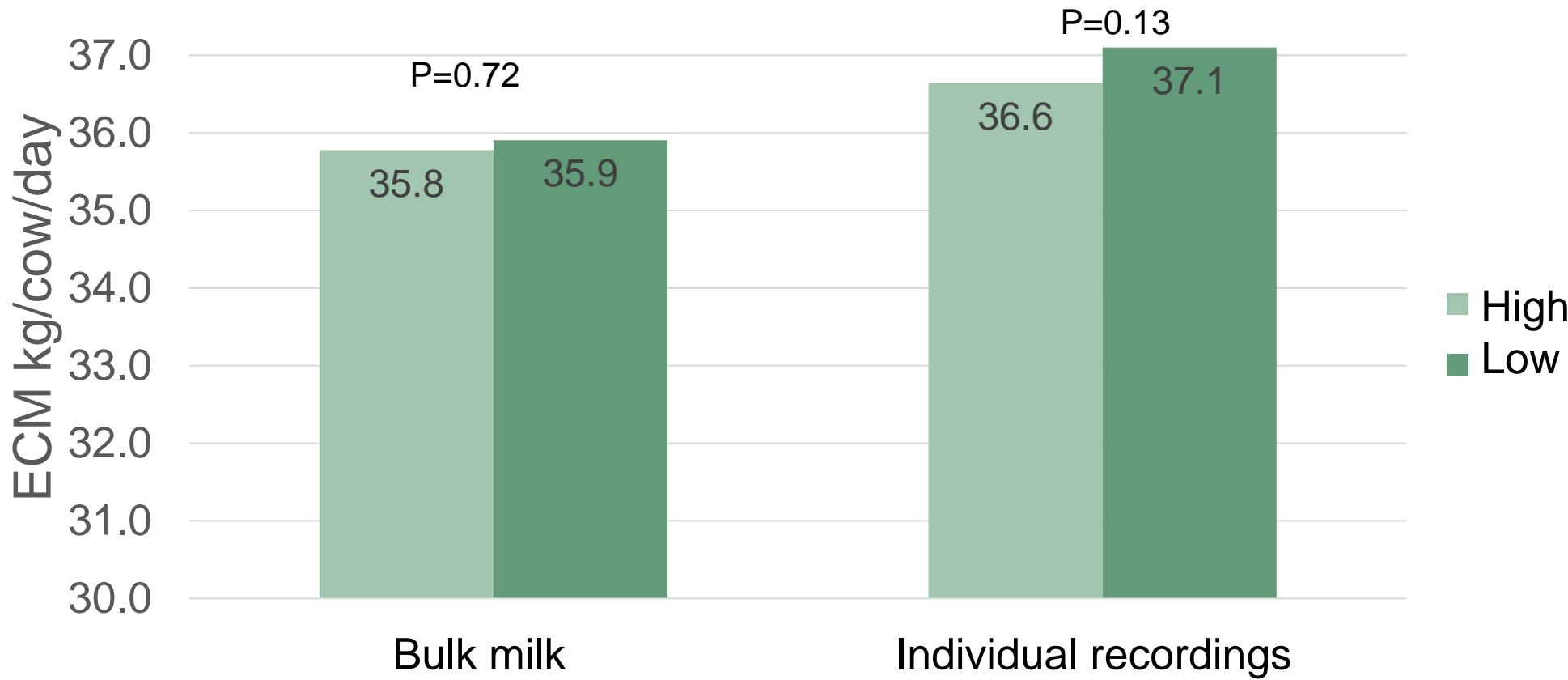


# Milk production

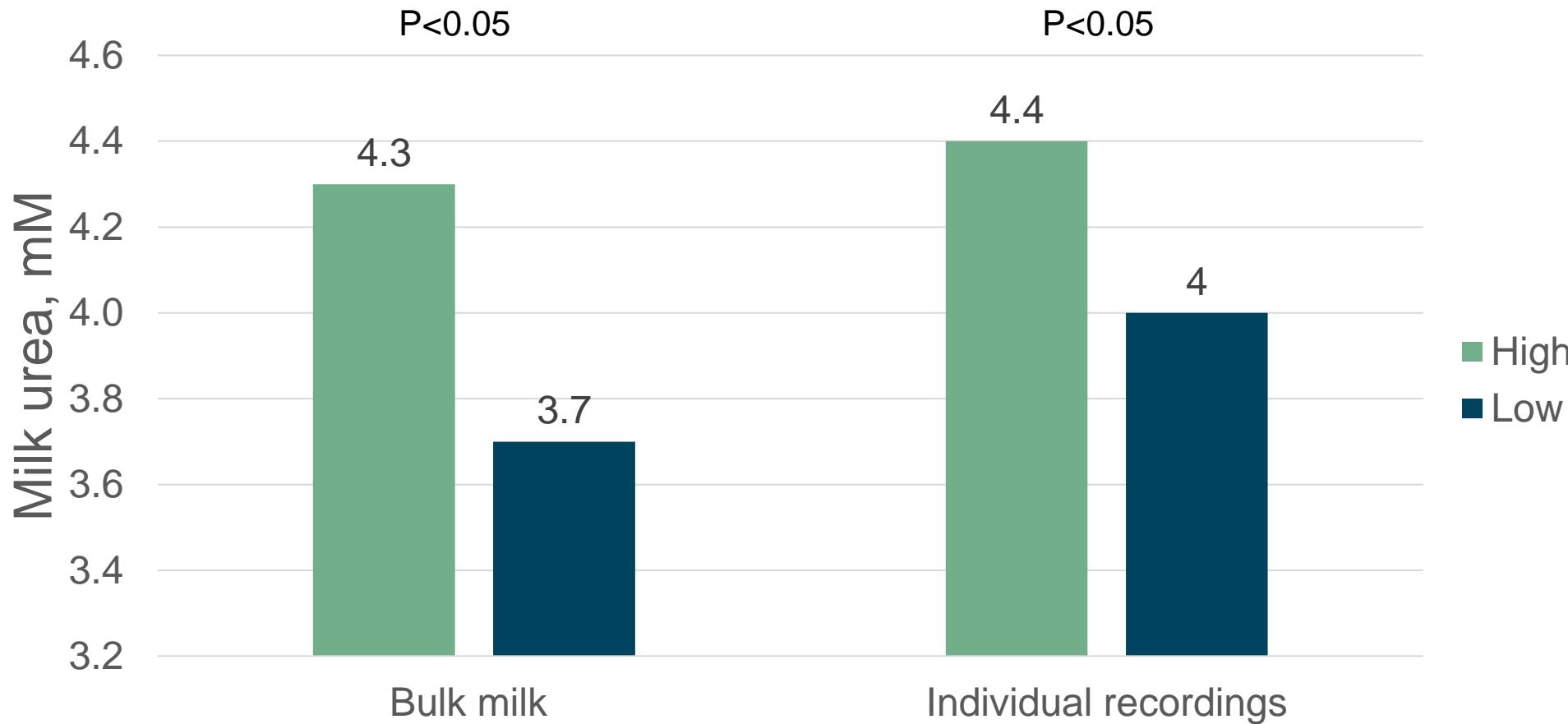
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# ECM-, fat- and protein-yield did not decrease



# Milk urea decreased



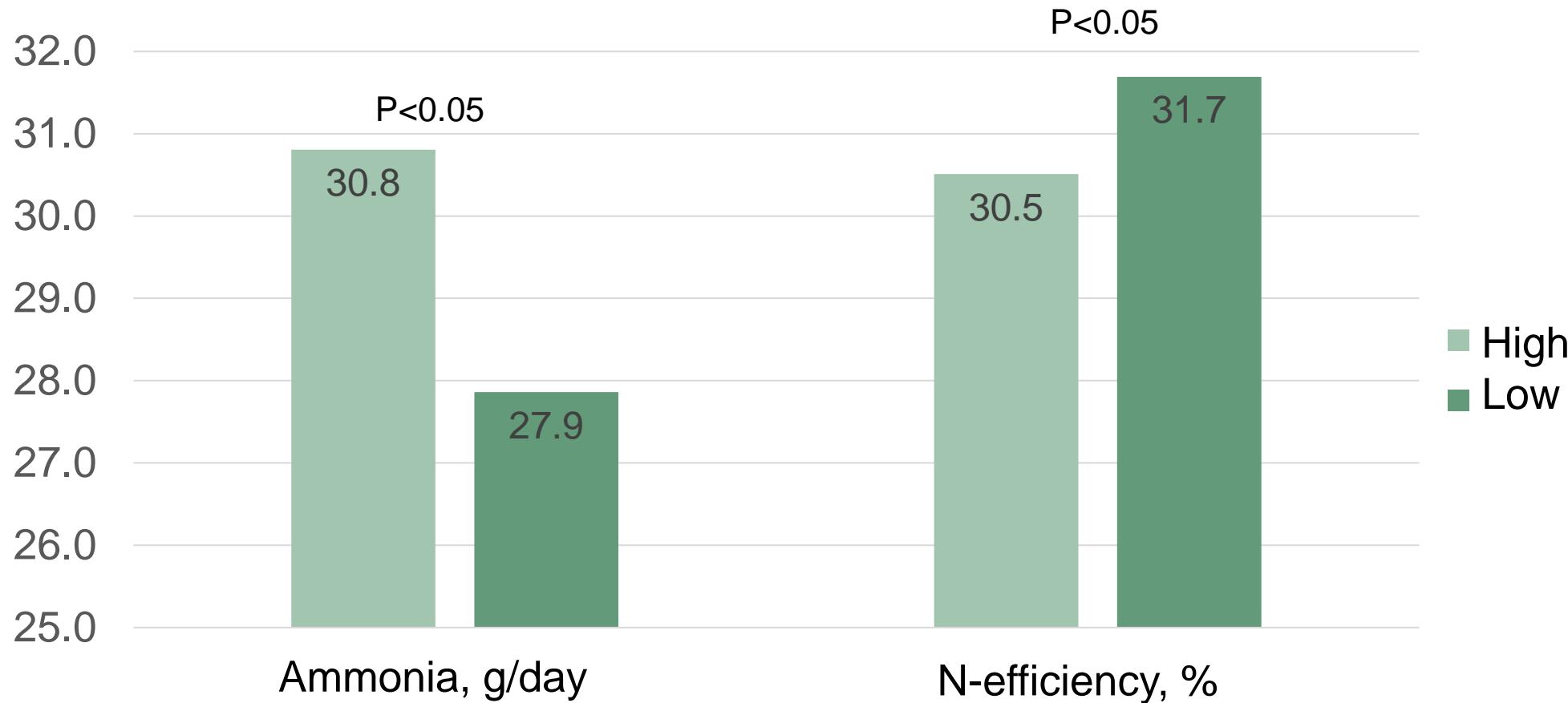
# Environment



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# Ammonia decreases



# Conclusion on reducing CP

- Same or better milk production reducing CP from 17.3 to 16.7%
- Less ammonia excretion and higher N-efficiency
- NDF and starch in feces were not affected
- Higher IOFC with low CP



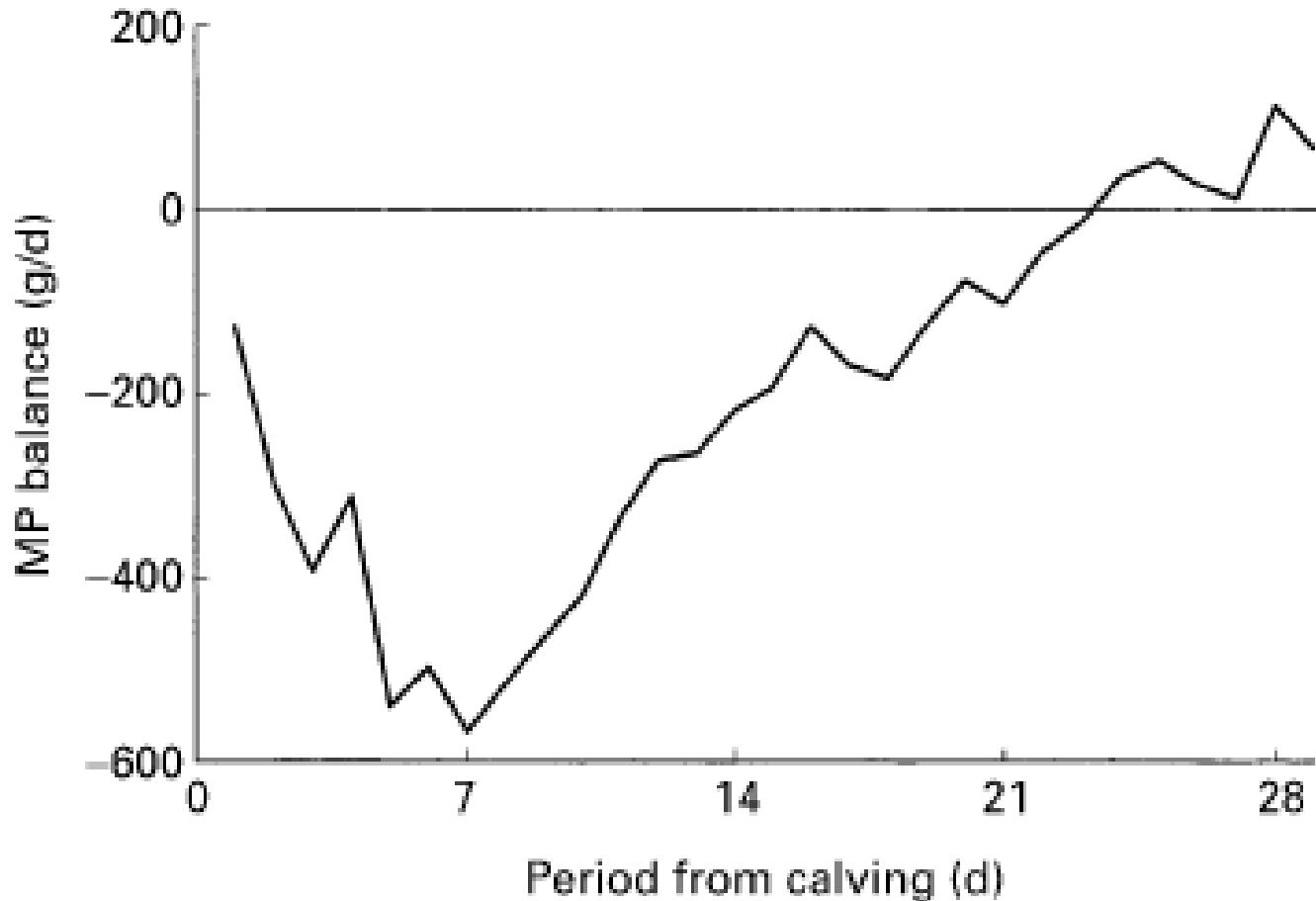
# Phase feeding of protein to maximize nitrogen efficiency in dairy systems



SmartCow

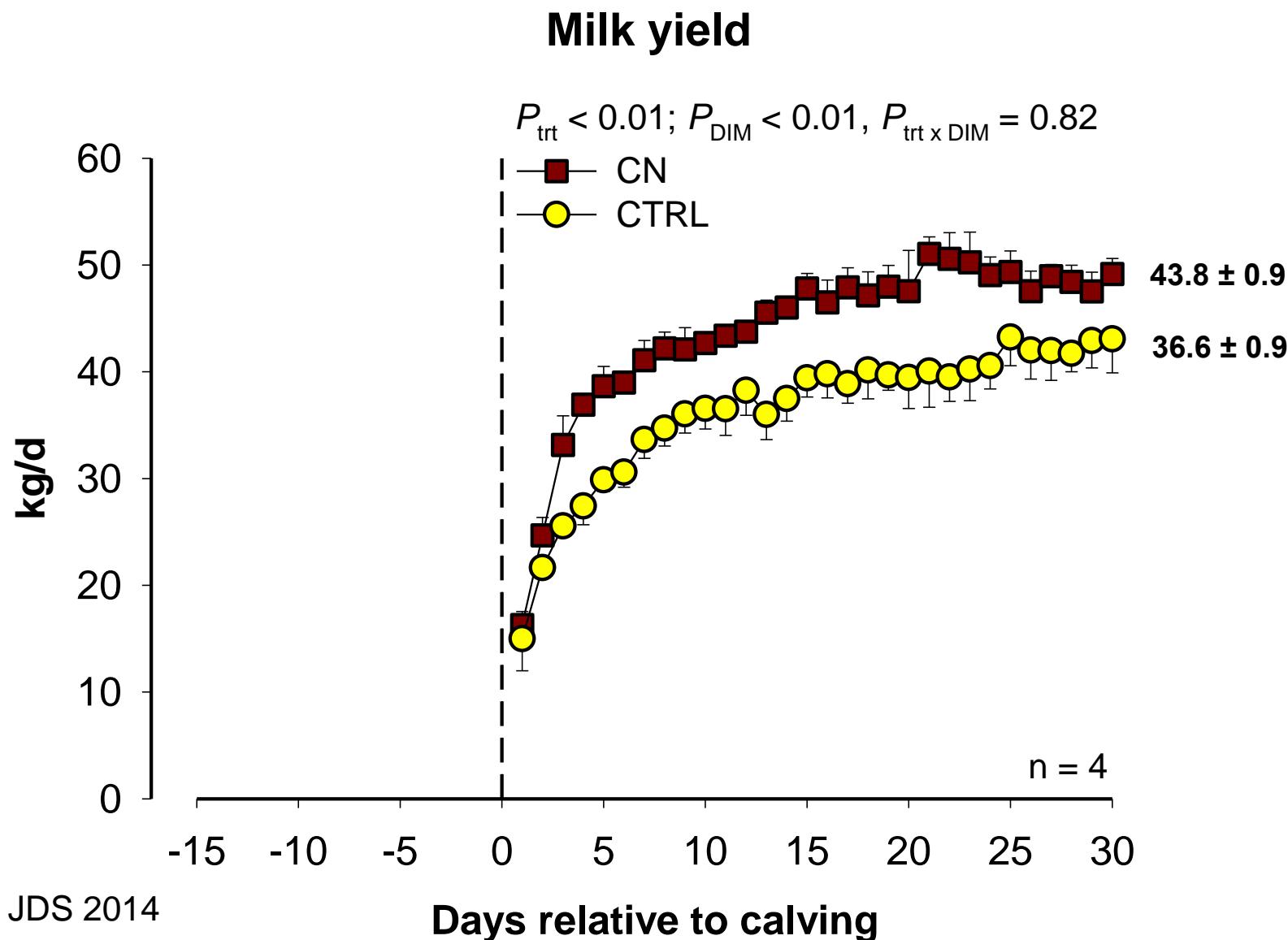
an integrated infrastructure for increased research capability and innovation in the European cattle sector

# Amino acid balance is negative first 3 weeks after calving

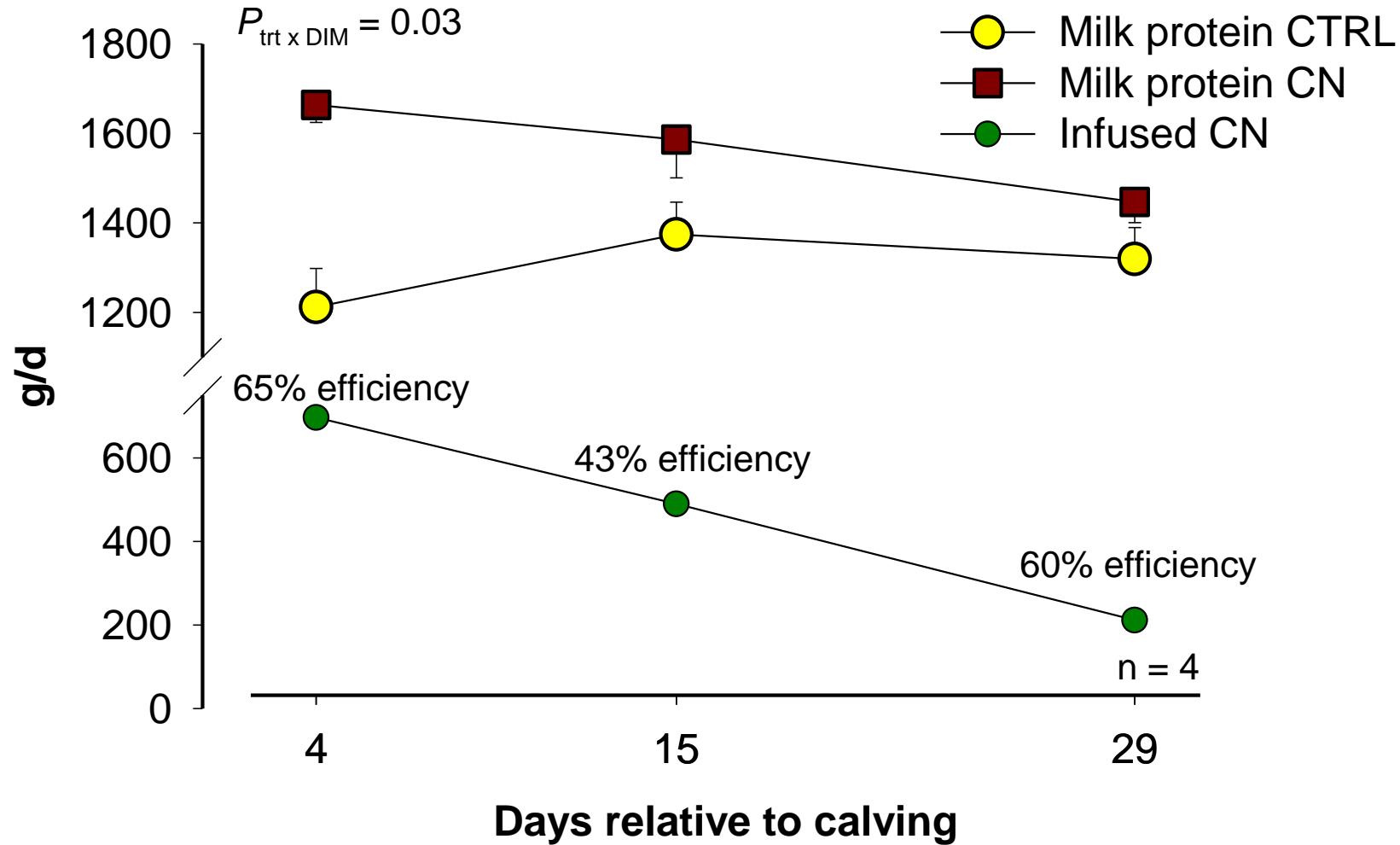


Bell et al., 2000

# Casein increases MY by 7 kg in older cows



# Utilisation of infused casein for milk protein is high



# Phase feeding of protein

- Idea
  - High supplementation of MP in early lactation
  - Lower supplementation of MP in mid and late lactation
- Advantage
  - Higher milk yield
  - Higher N-efficiency and less ammonia
- Disadvantage
  - Expensive protein sources in early lactation
  - Need for concentrate feeders or grouping of cows



## Research questions - Phase feeding trial at Reading University

- Will cows perform 7 kg extra ECM with SoyPass and Corn gluten meal ?
- Will the effect on milk yield the first 4 weeks of lactation carry over to the following weeks ?
- Are different strategies for phase feeding of importance for the carry over effect ?
- How much can we improve N-efficiency ?



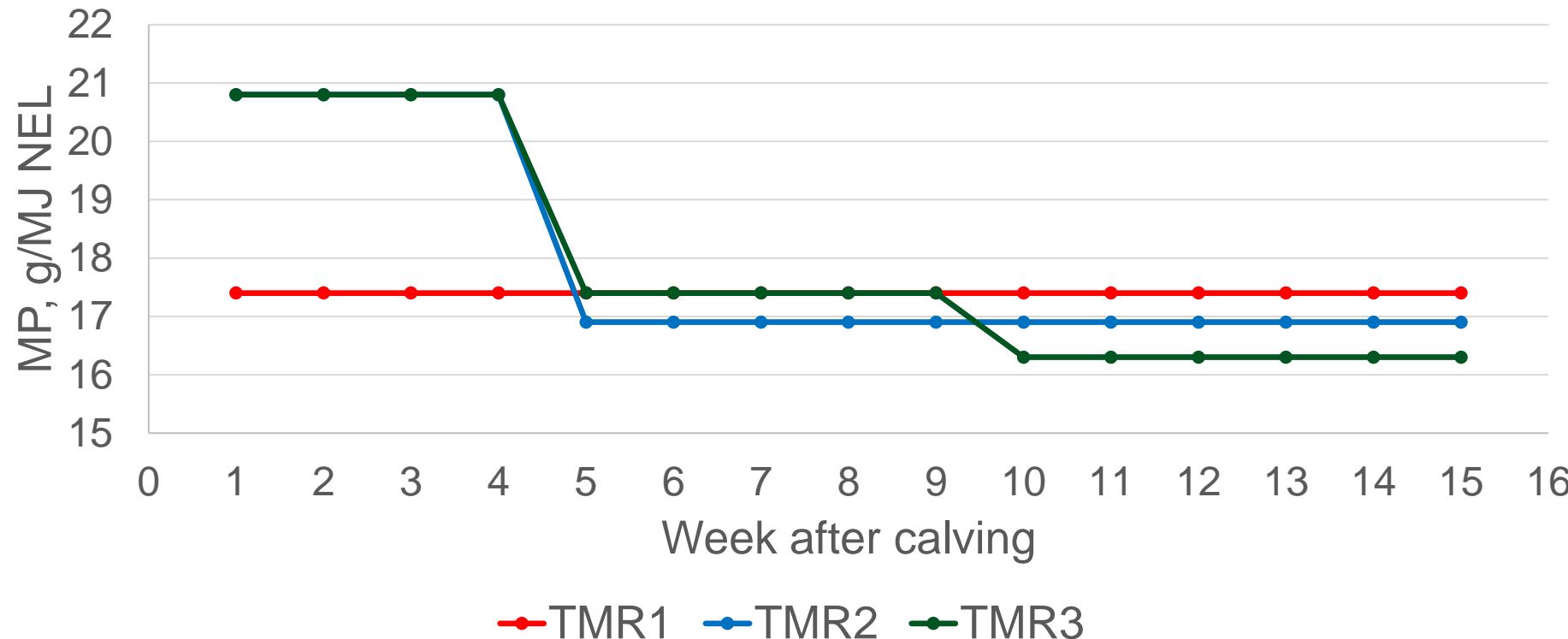
# Design

- 3 treatments: TMR1, TMR2 & TMR3
- 12 older Holstein cows on each treatment
- Cows were monitored first 15 weeks after calving
- Treatments began 4-5 days after calving
- SoyPass & corn gluten meal as MP-rich feedstuffs



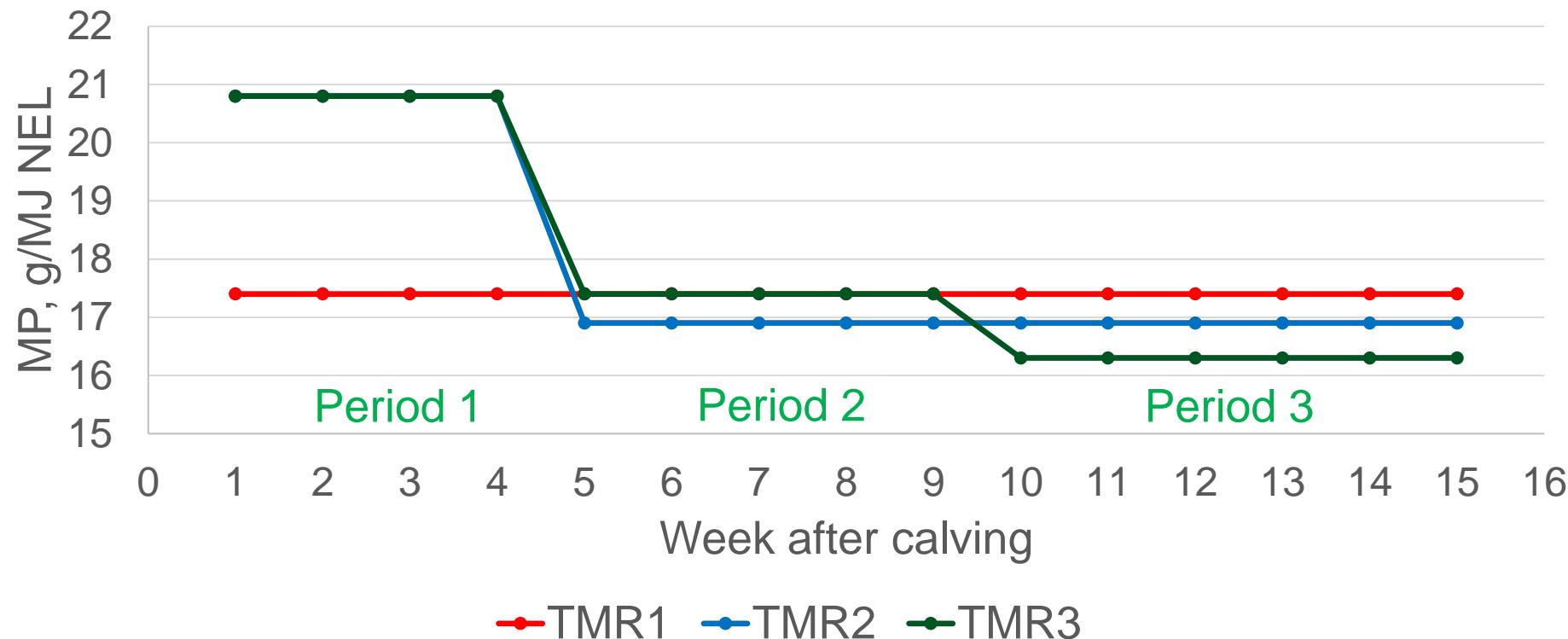
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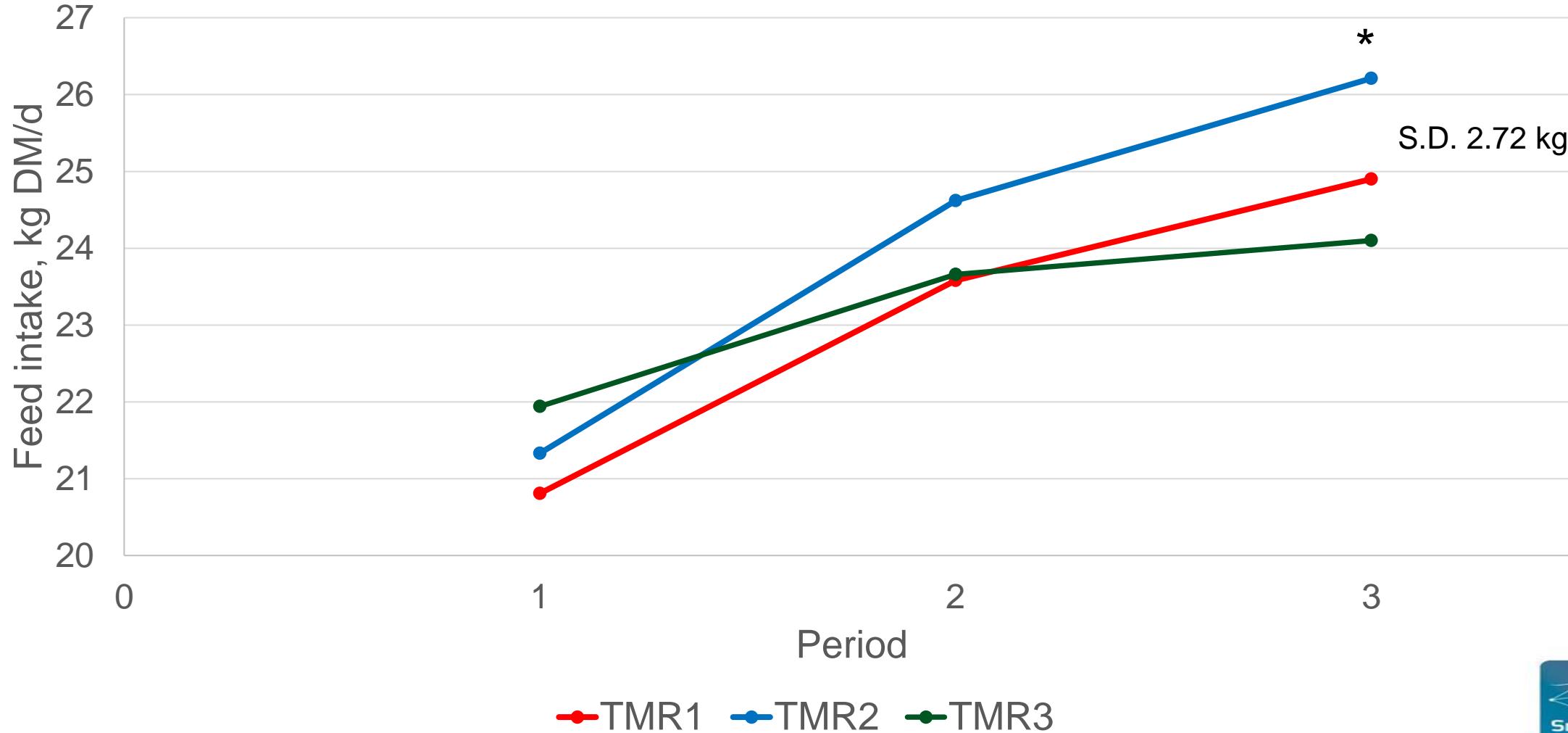


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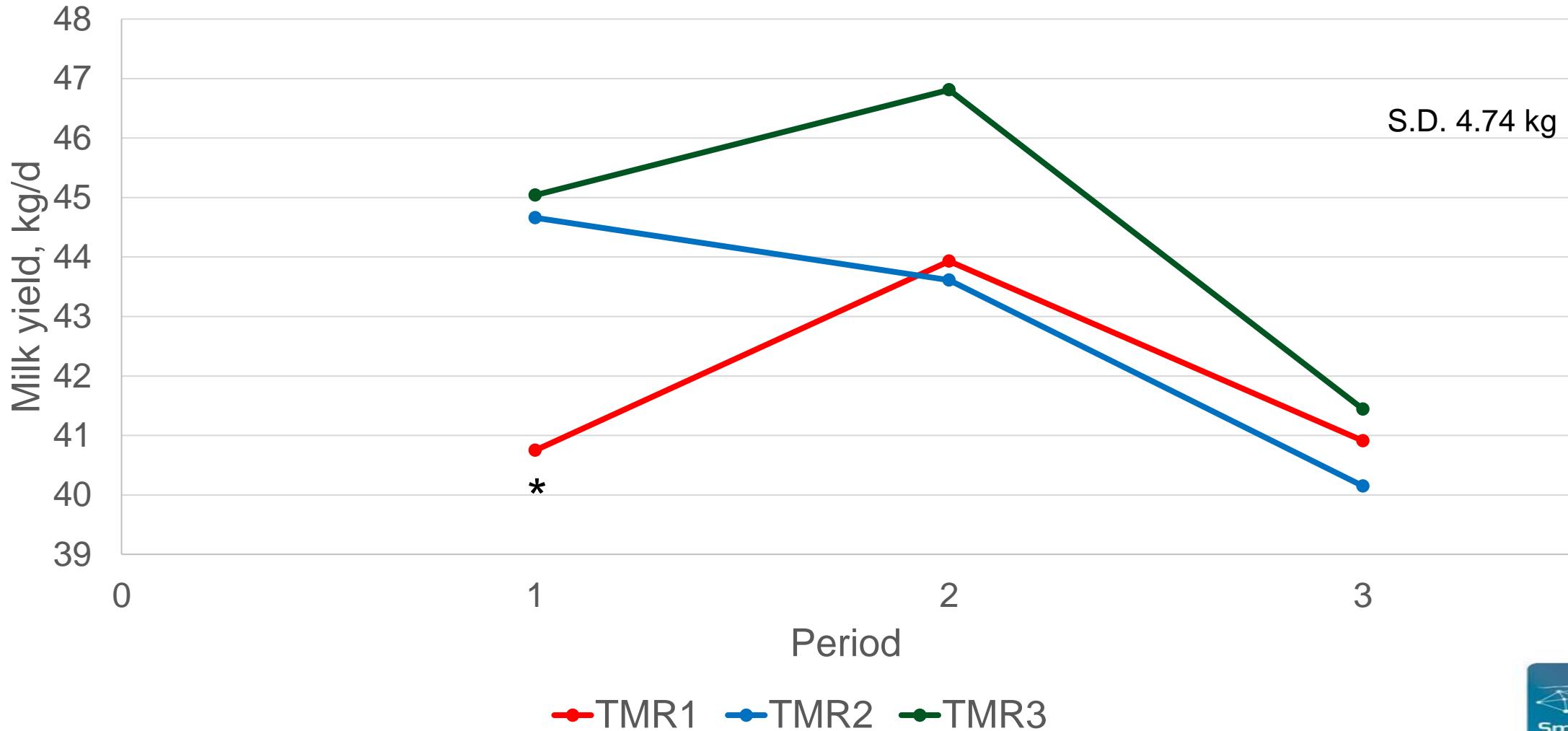
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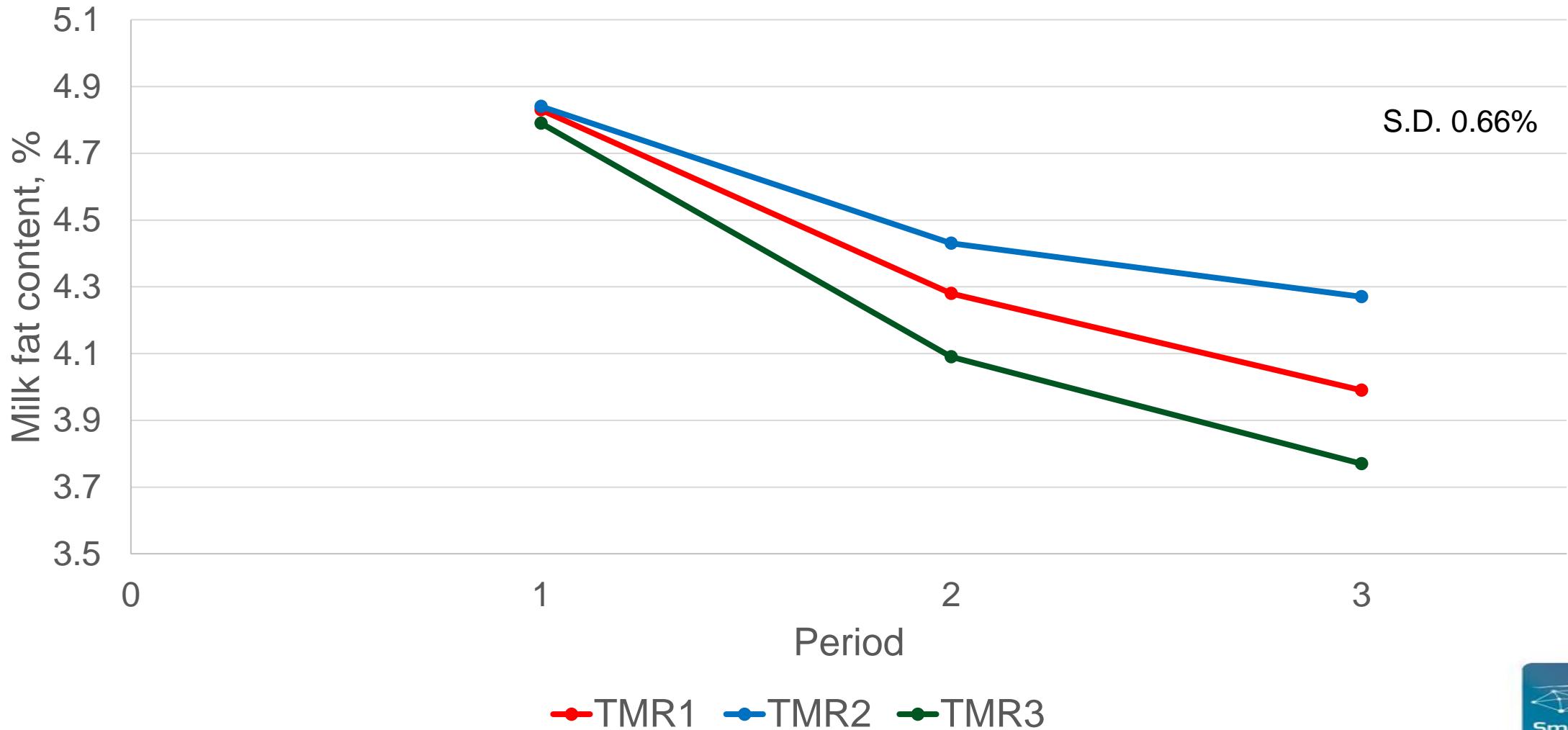
# Feed intake



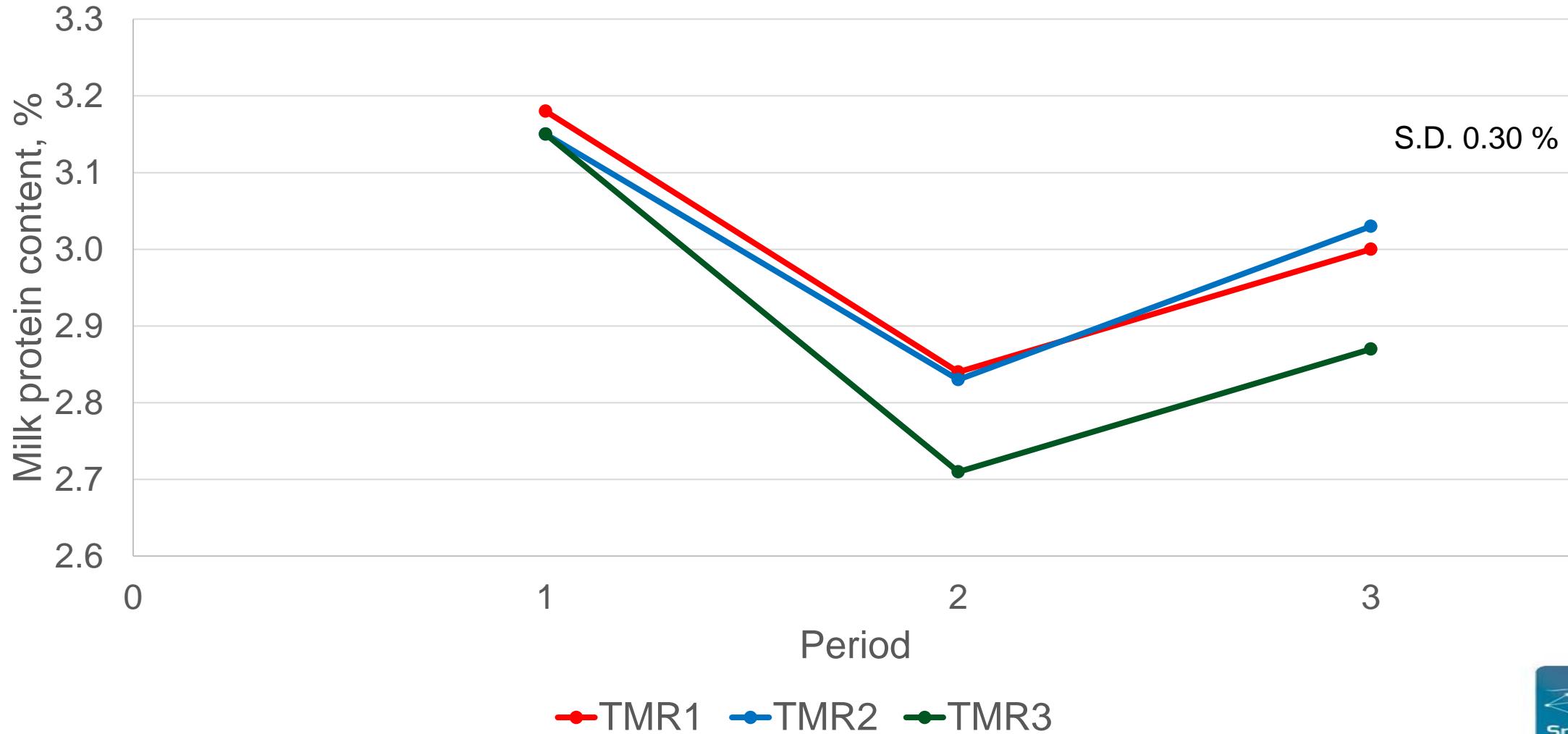
# Phase feeding increases MY by 4 kg



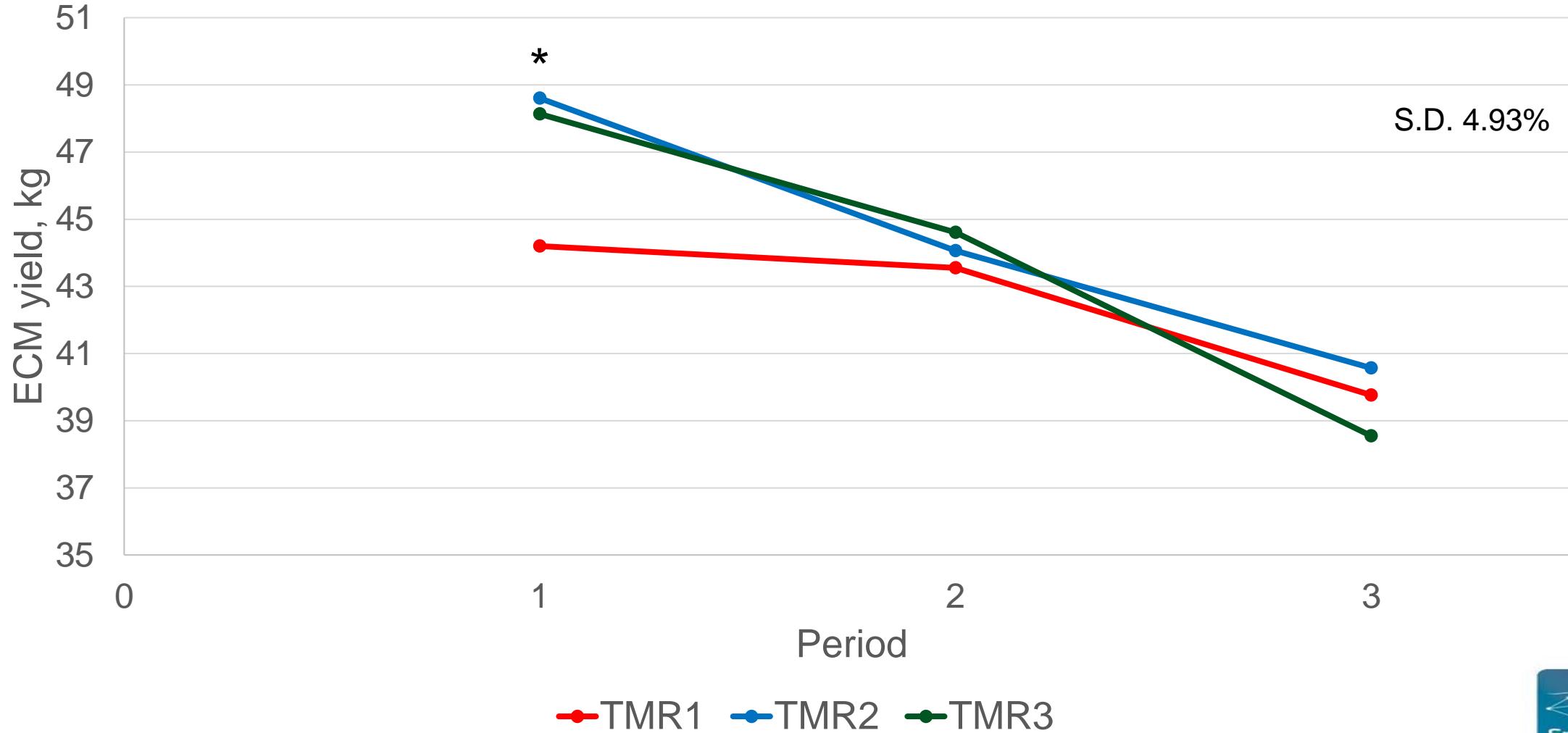
# Milk fat



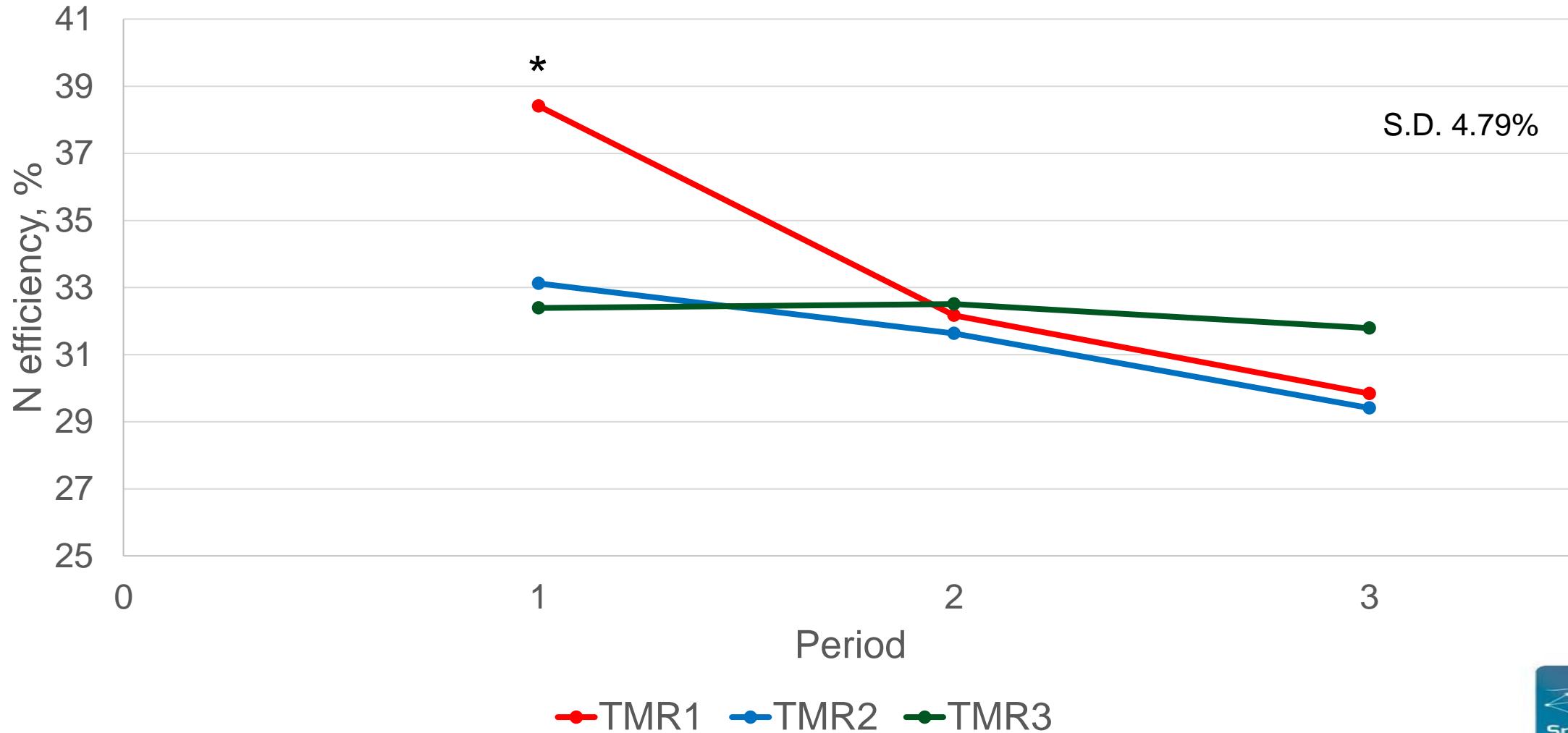
# Milk protein



# ECM-yield



# N-efficiency

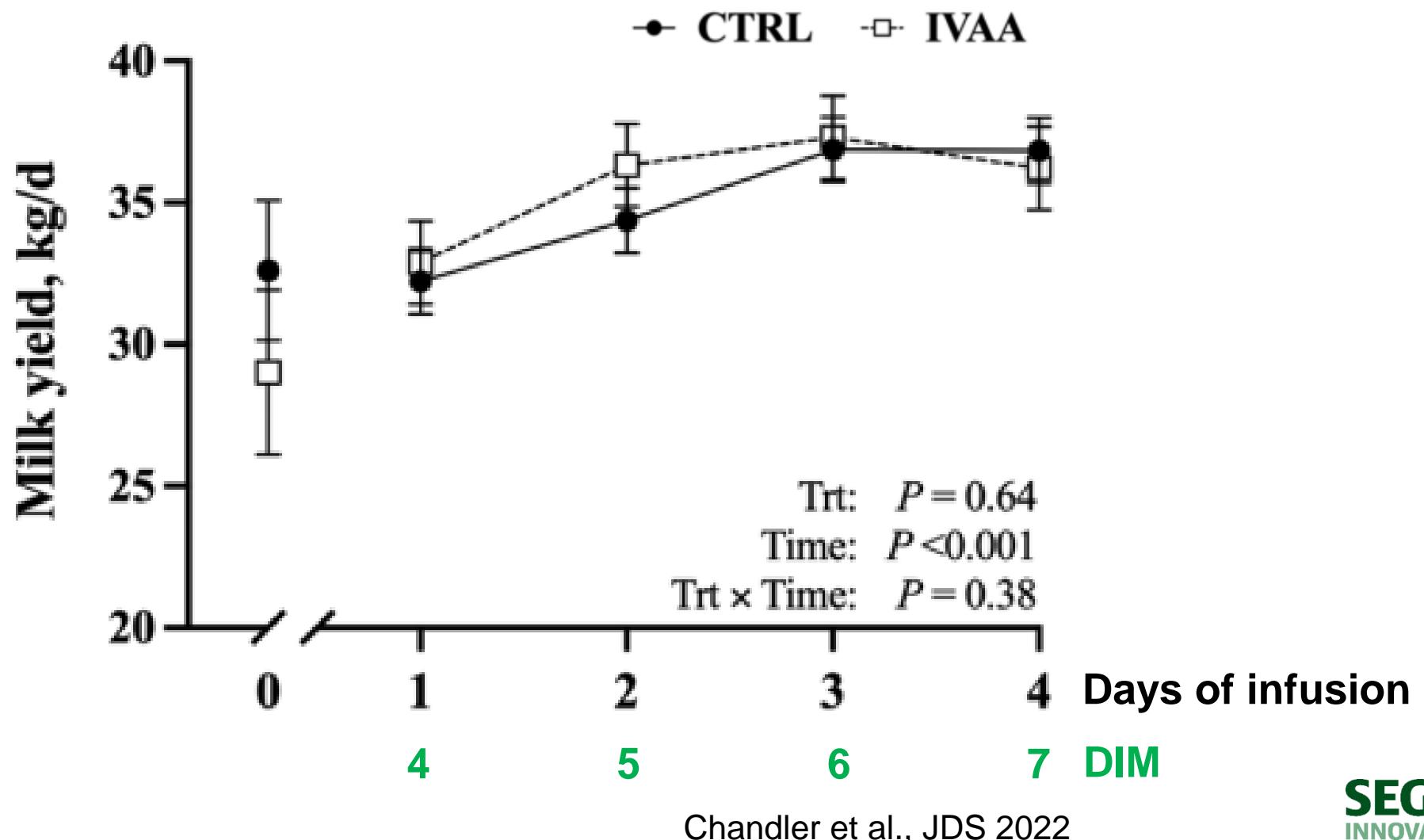


# Conclusion

- Will cows perform 7 kg extra ECM with SoyPass and Corn gluten meal ?
  - Partly, 4 kg ECM
- Will the effect on milk yield the first 4 weeks of lactation carry over to the following weeks ?
  - NO
- Are different strategies for phase feeding of importance for the carry over effect ?
  - NO
- How much can we improve N-efficiency ?
  - We were not able to improve it by phase feeding



# When to initiate treatment of extra MP ?

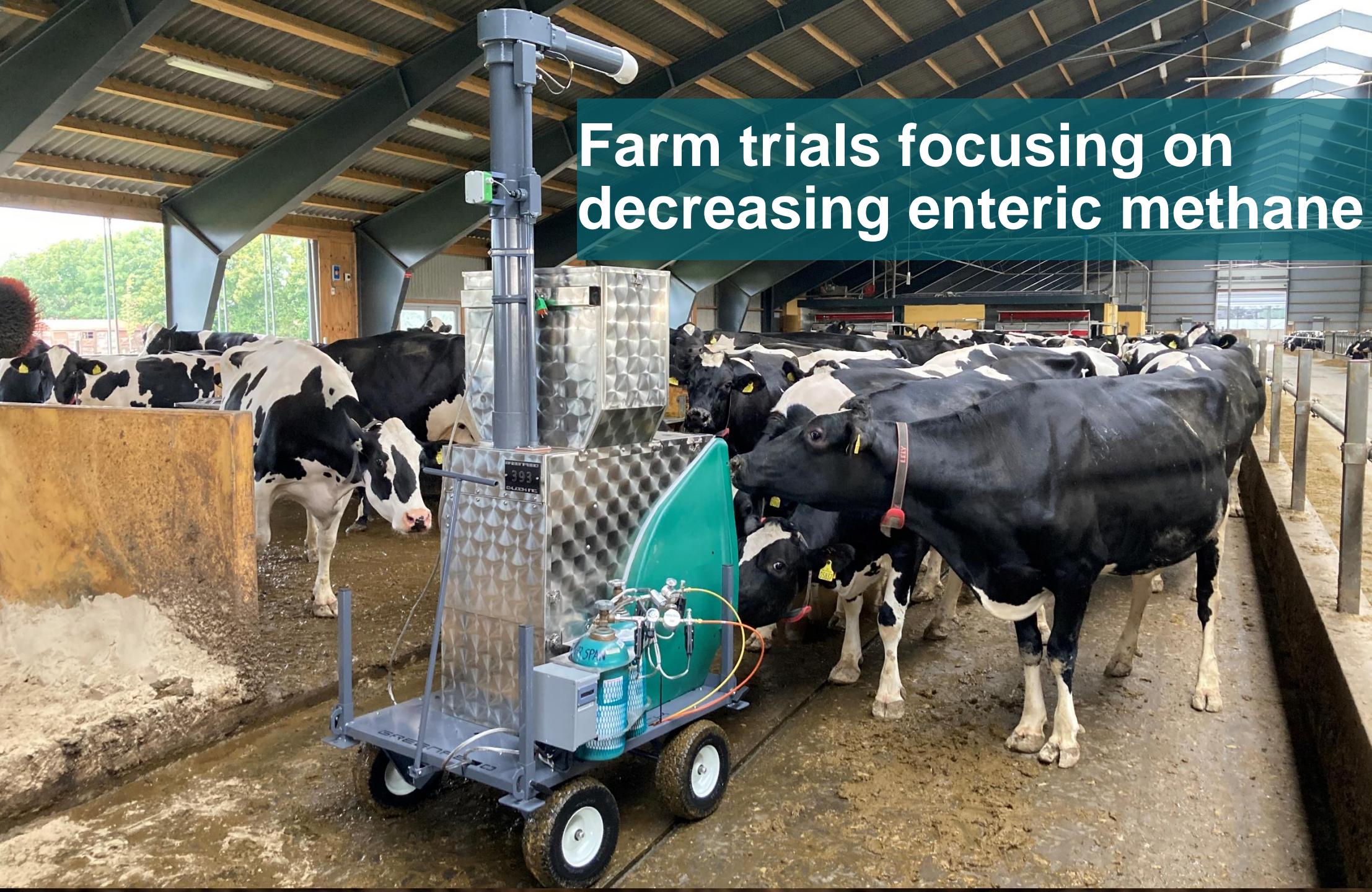


# Acknowledgements

- Dave Humphries & Chris Reynolds, Reading University



# Farm trials focusing on decreasing enteric methane



# Danish Climate Law puts pressure on the dairy sector



- 0,17 mio tons CO2e in 2025 (6%)
- 1,0 mio tons CO2e in 2030 (35%)

# Nutritional strategies to reduce methane



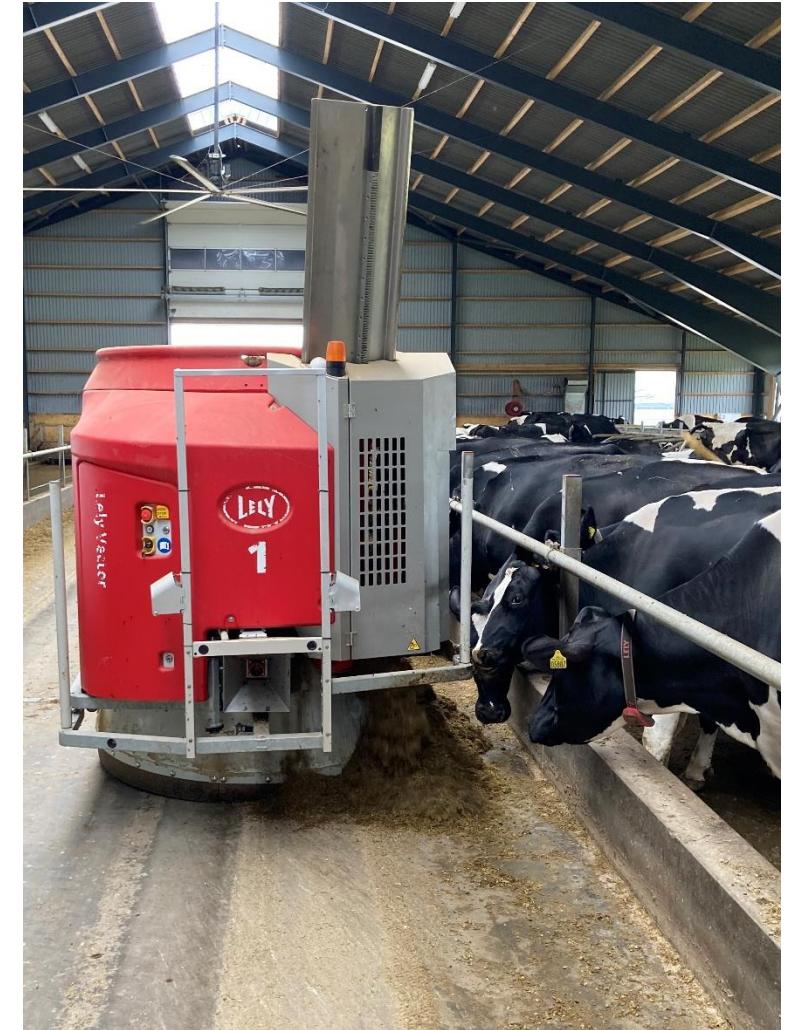
- Higher digestibility of grass silage
- Higher proportion of maize silage
- Grazing
- Feeding more starch
- Feeding more fat
- Concentrate/roughage
  - Limited potential in typical Danish diets
  - Feed additives have greater mitigation potential ?

# Purpose with test of Bovaer®

- Can we mix and feed ~1.5 gram 3NOP/cow/day ?
- How much can it reduce methane in commercial herds ?
- Does Bovaer affect the feed intake or milk production ?
- Is the effect of Bovaer consistent across farms ?

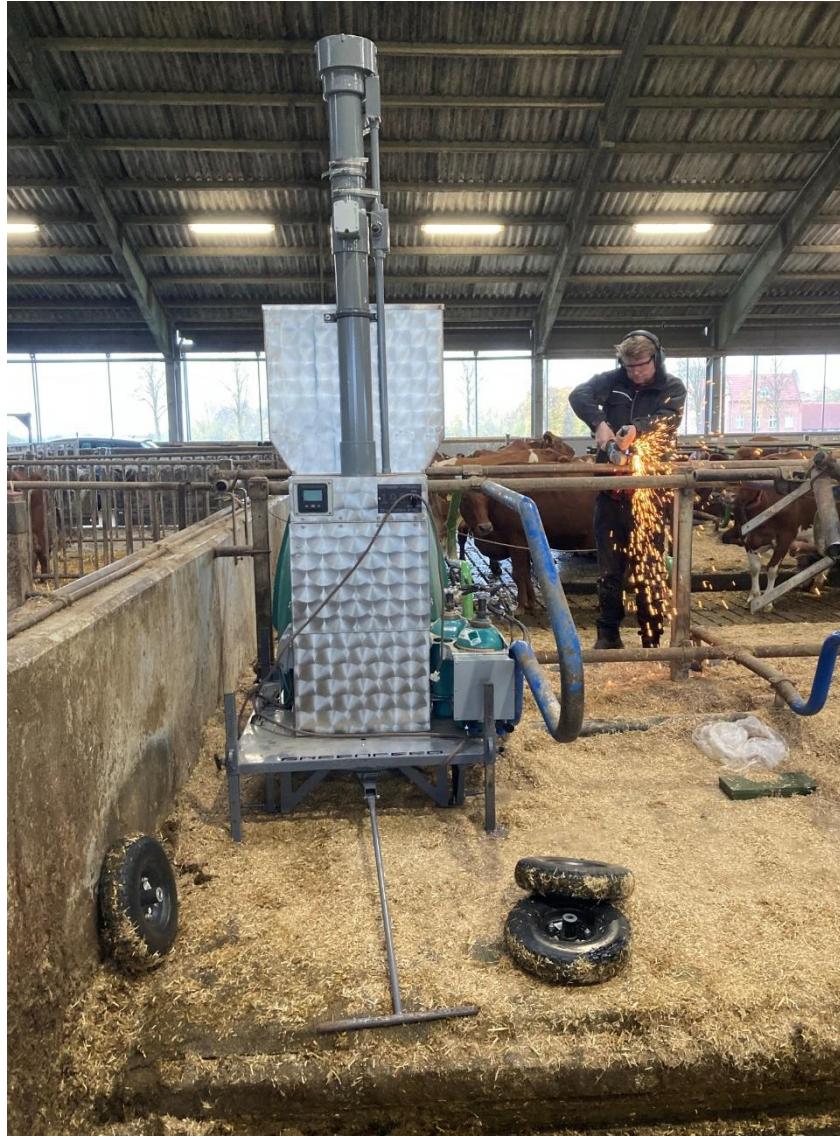


# Bovaer mixed in minerals and fed via TMR or PMR (60 mg/kg DM)

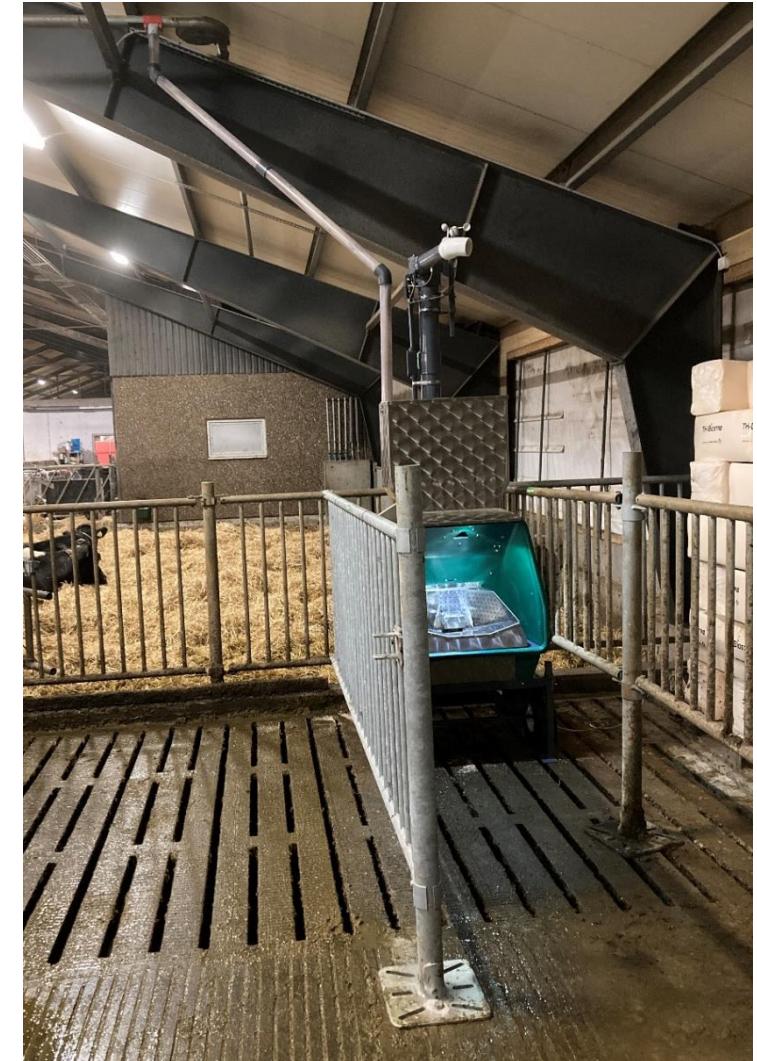


1,5 g 3NOP/cow/day

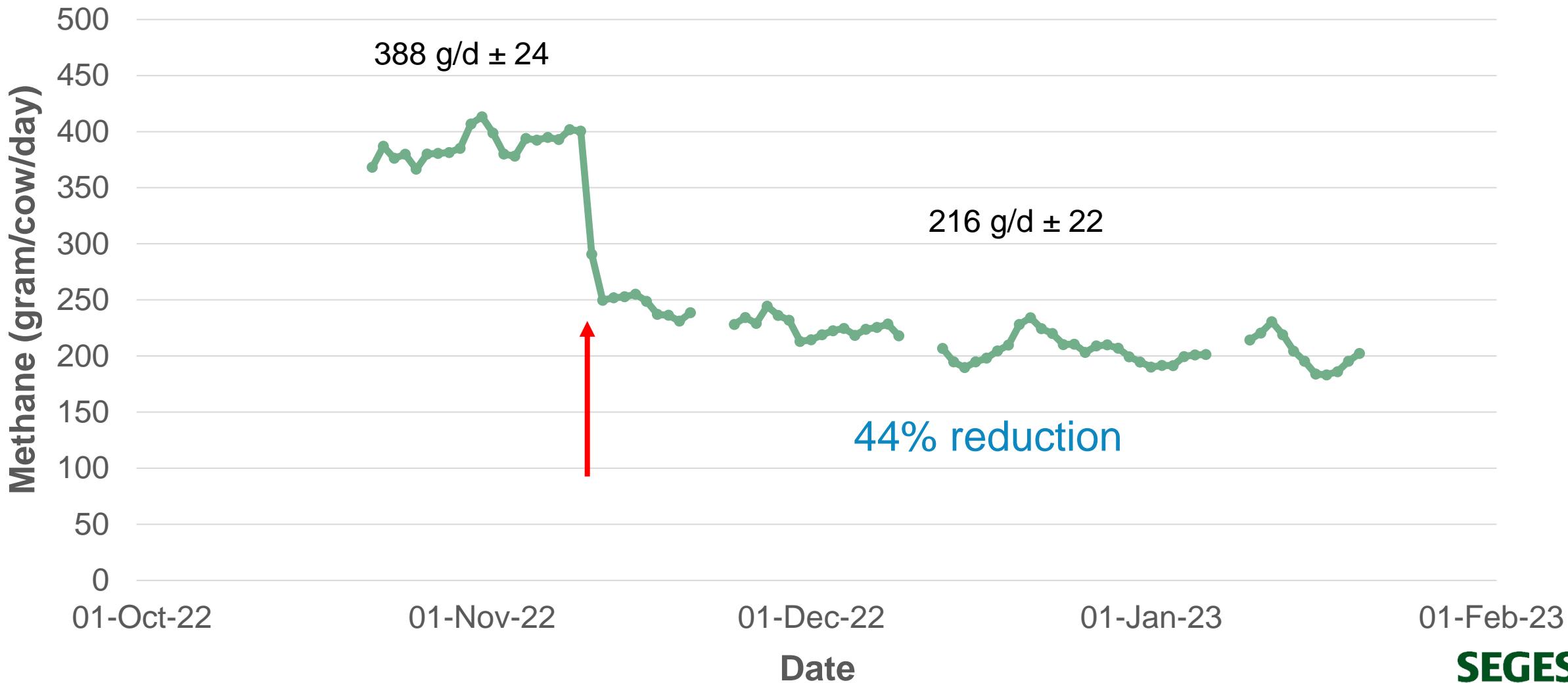
# Installation of GreenFeed units in cubicles



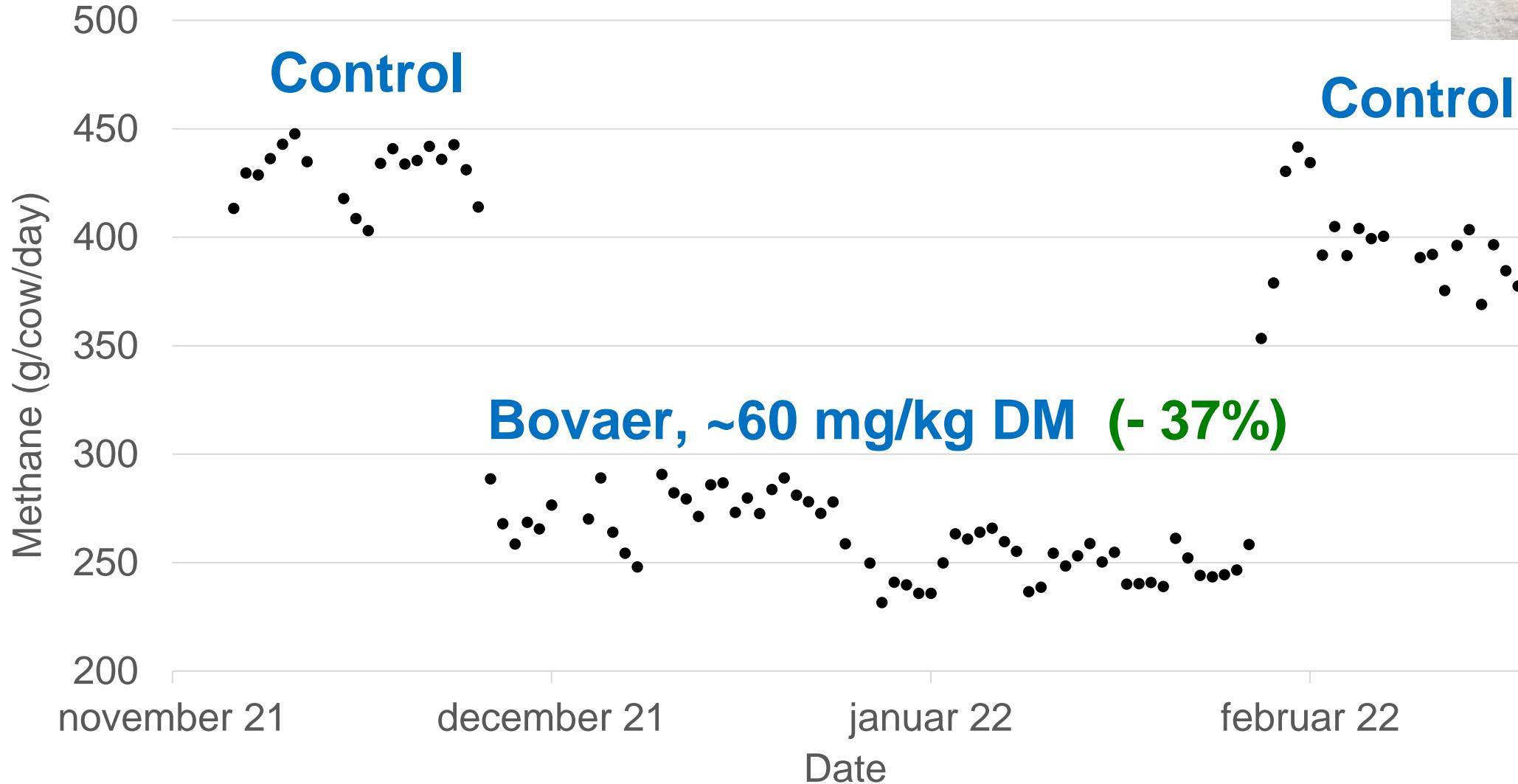
# Installation of GreenFeed on slatted floors



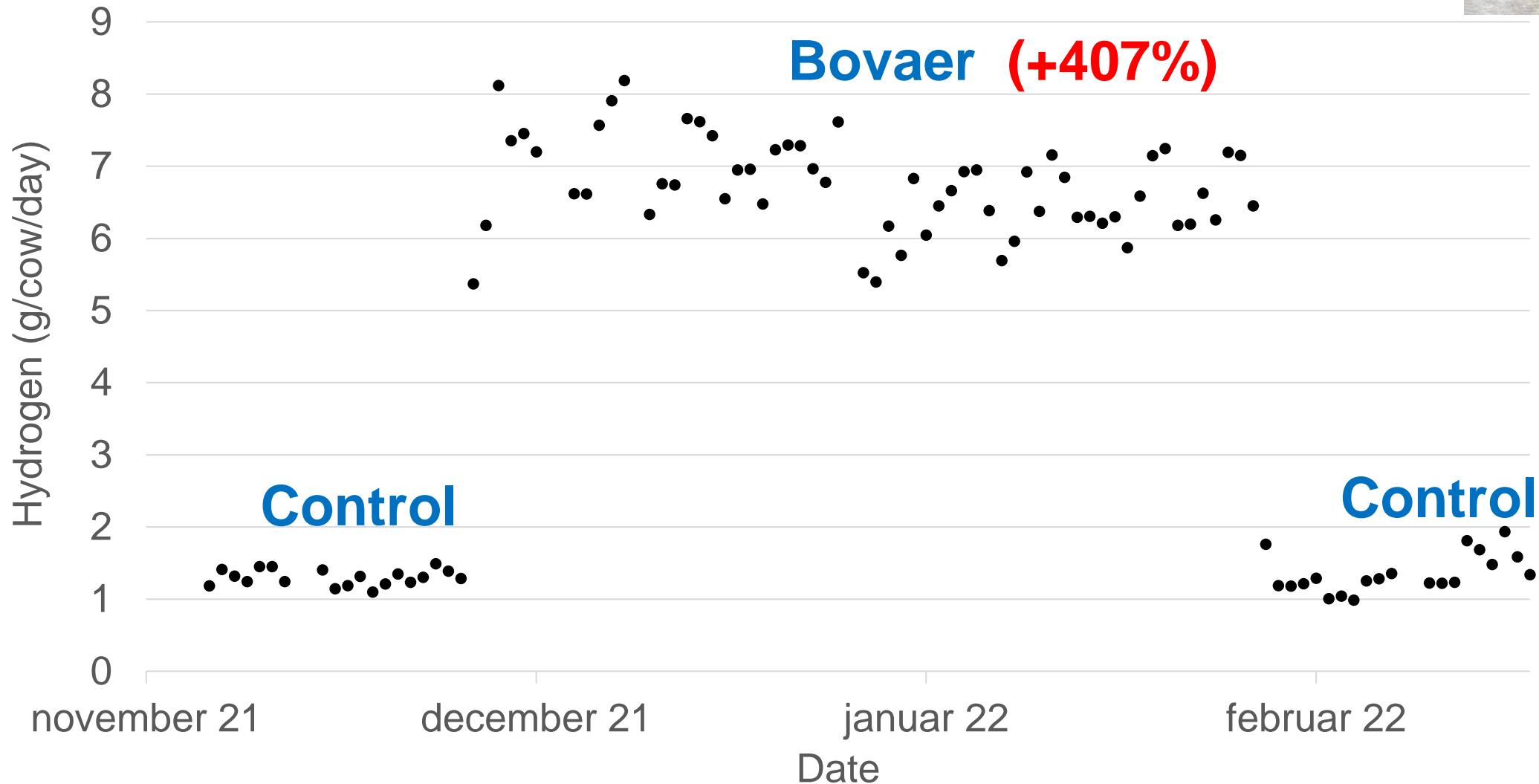
# Effect of Bovaer on enteric methane production (n=57 Holstein cows)



# Methane (n=36 red cows)



# Hydrogen (n=36 red cows)



# Feed intake and milk production

	Control	Bovaer	significance
DMI (kg/d)	22.4	22.1	n.s.
Milk yield (kg/dag)	28.2	28.3	n.s.
Milk fat (%)	4.79	4.77	n.s.
Milk protein (%)	3.75	3.77	n.s.
ECM (kg/d)	31.9	32.1	n.s.

# Conclusion



- Bovaer can be mixed and fed to cows on commercial farms
- Supplementation of Bovaer via minerals consistently reduce methane significantly (26-44%) in maize silage based diets
- Bovaer reduces methane across dairy breeds
- Hydrogen emission are increased several fold
- 60 mg 3NOP/kg DM does not affect feed intake and milk production
- Feed additives are likely to be a part of a resilient dairy sector



Danish Crown



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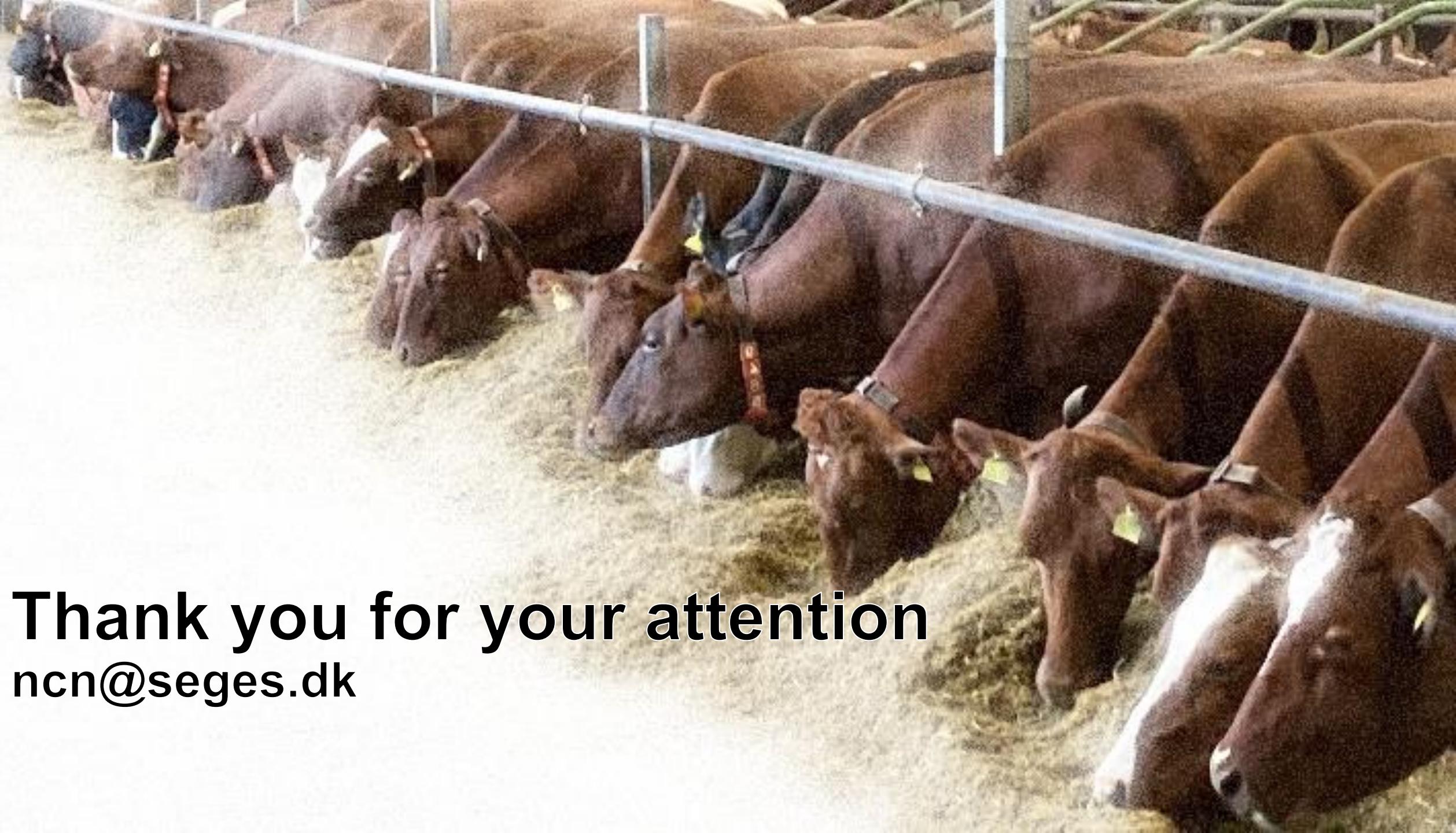


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**Thank you for your attention**  
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