

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



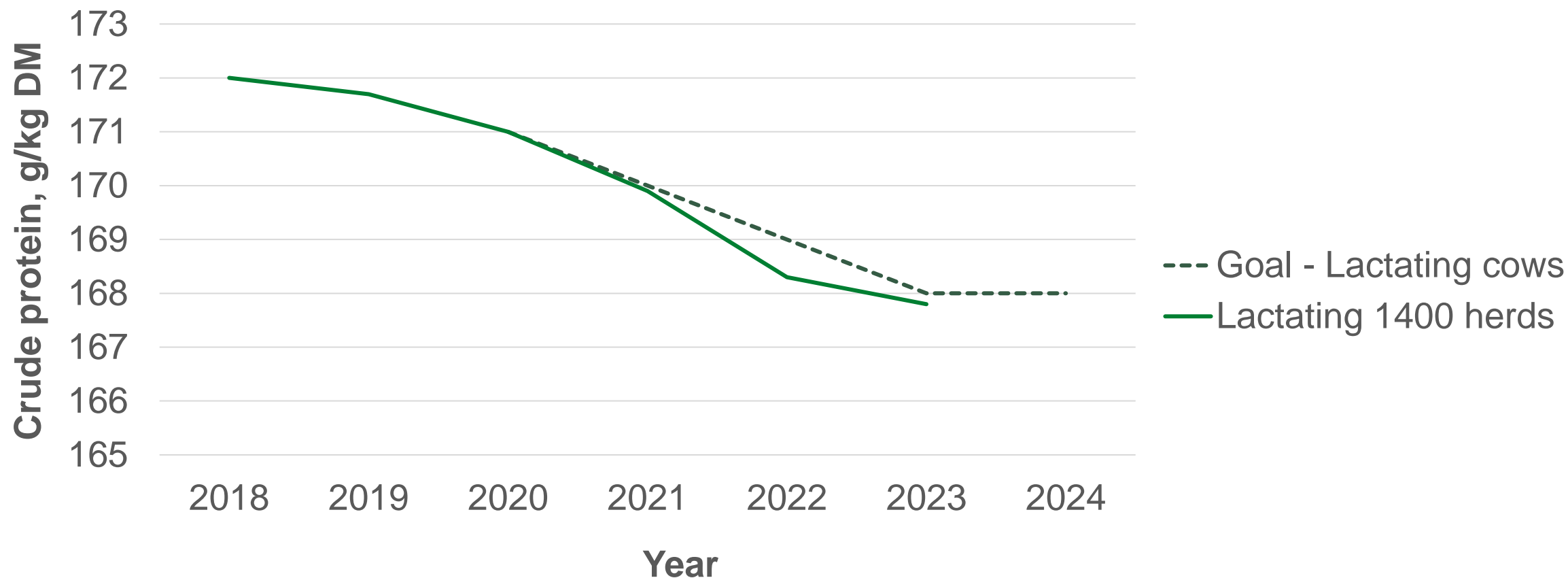
SEGES Innovation is private, non profit and independent R&D within Agriculture



- 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



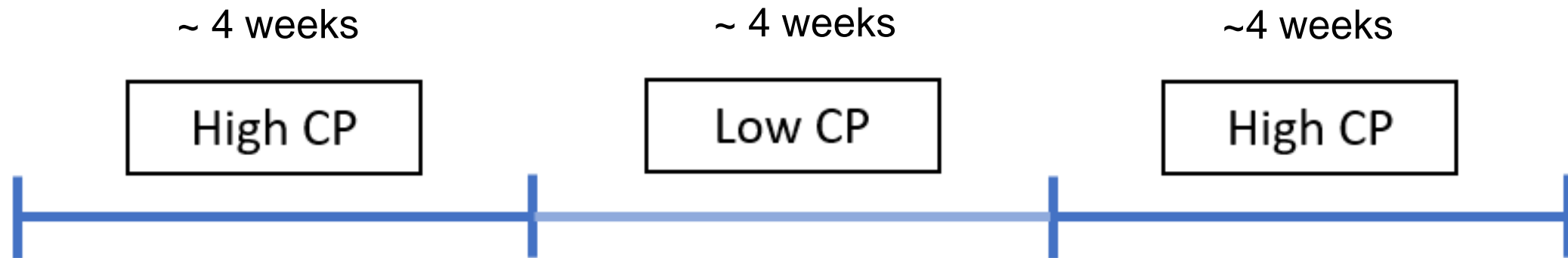
CP-level (g/kg DM) from dairy farms (Lactating cows, 2022)

	10%	25%	Median	75%	90%
Jersey, n=181	161	165	170	175	180
Large breed, n=1232	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



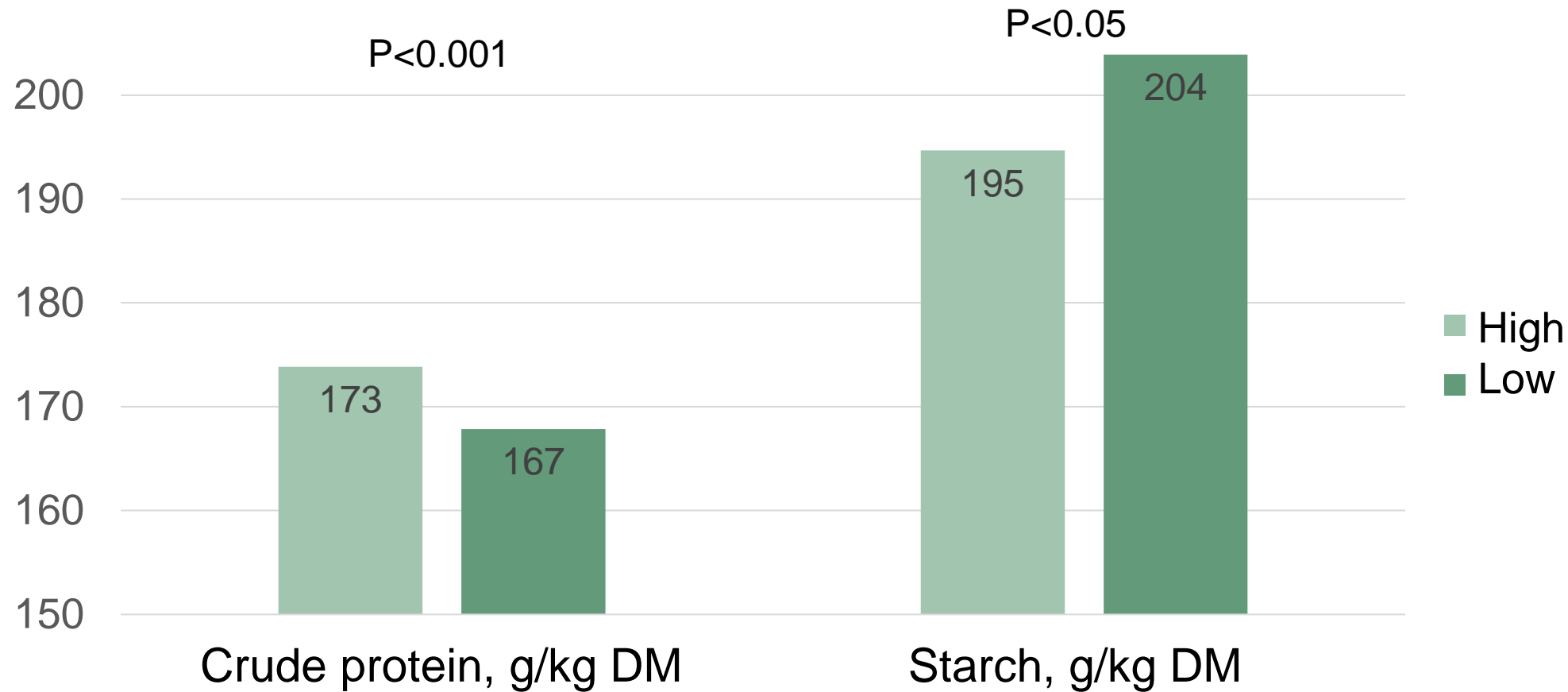


Results – Nutrients

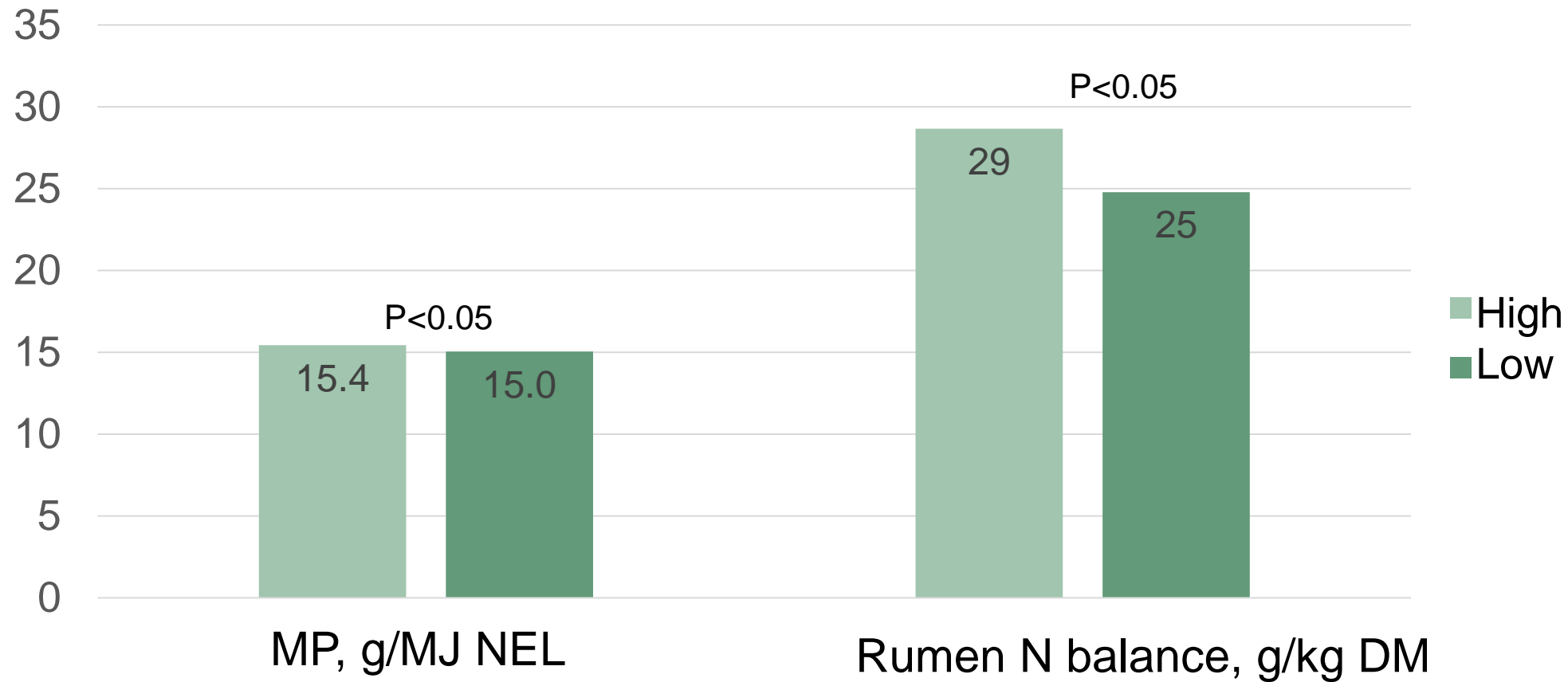
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Crude protein and starch



MP and rumen N balance



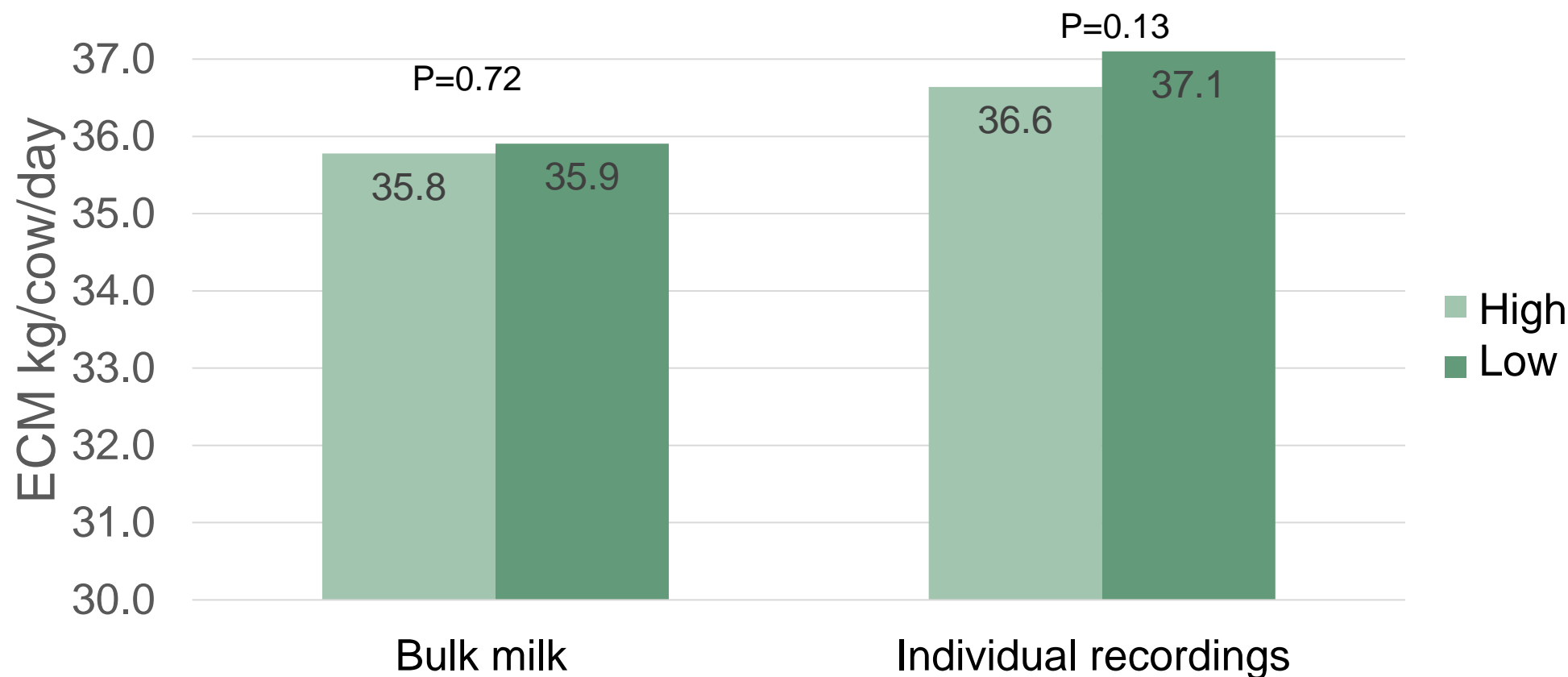


Milk production

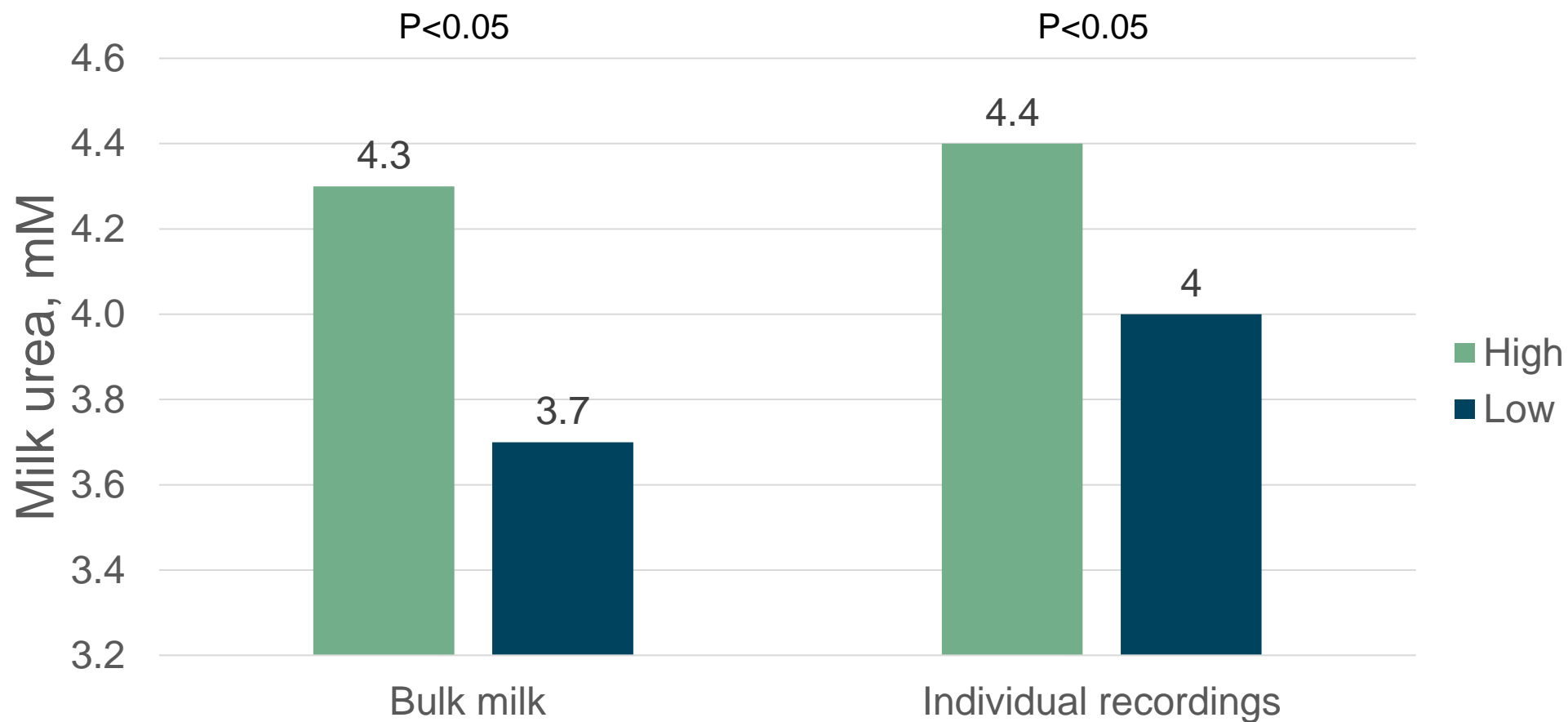
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ECM-, fat- and protein-yield did not decrease



Milk urea decreased



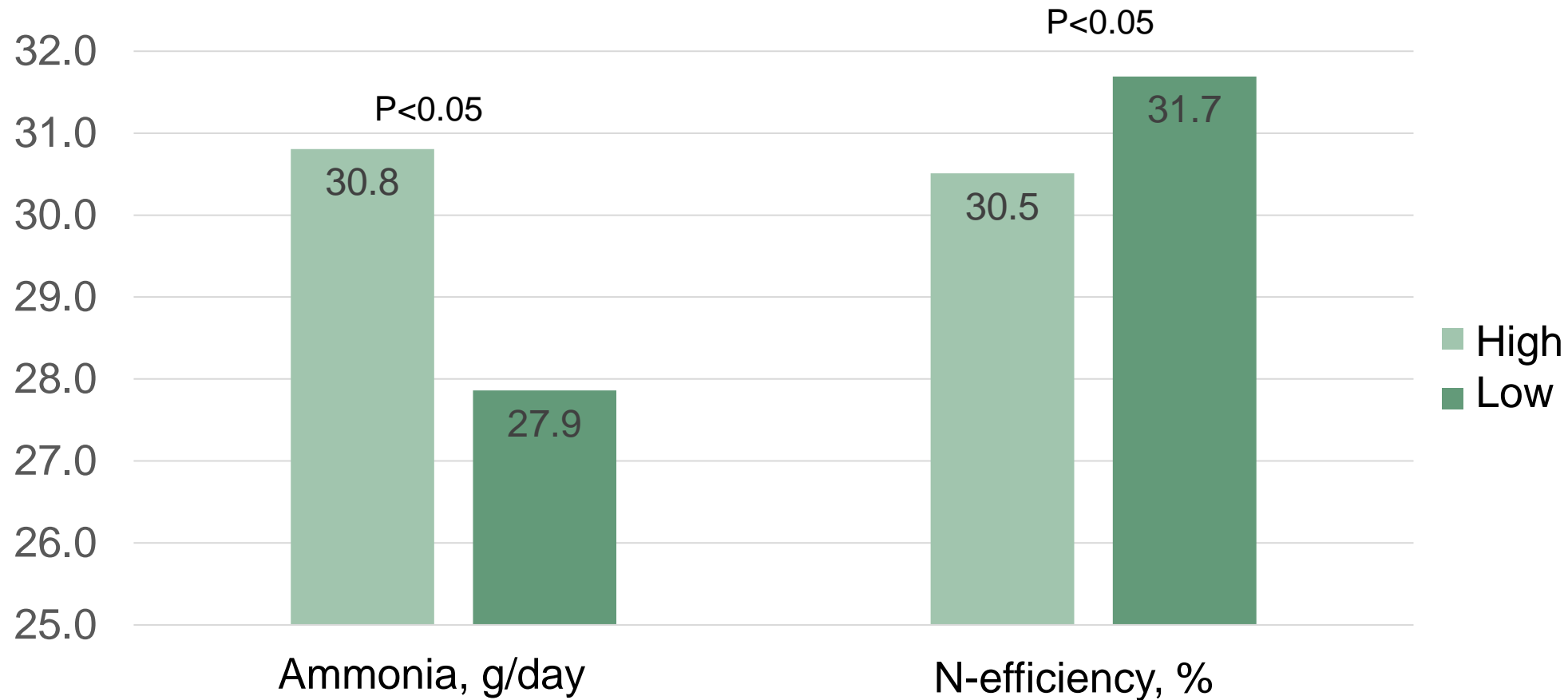
Environment



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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



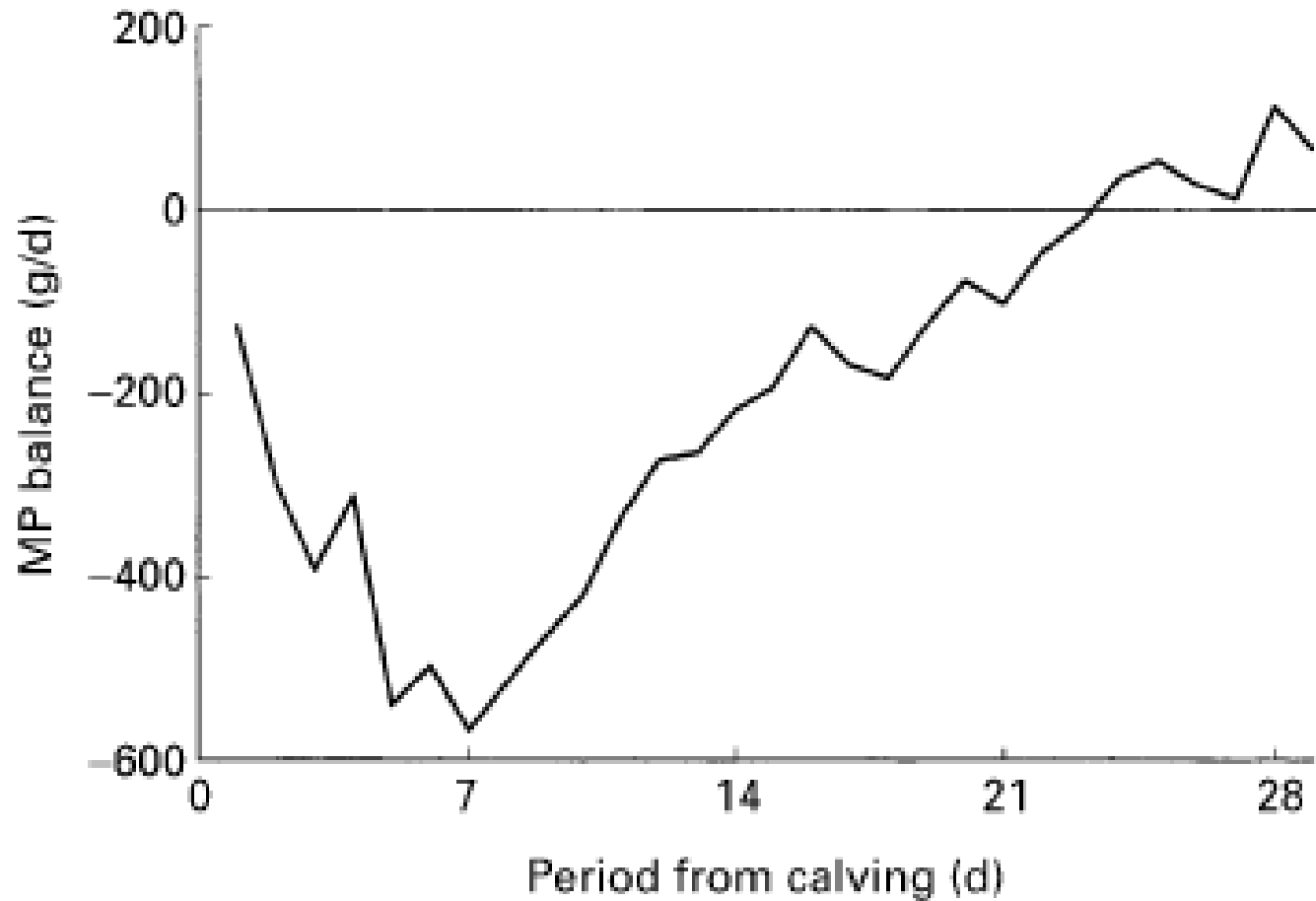
Phase feeding of protein to maximize nitrogen efficiency in dairy systems



SmartCow

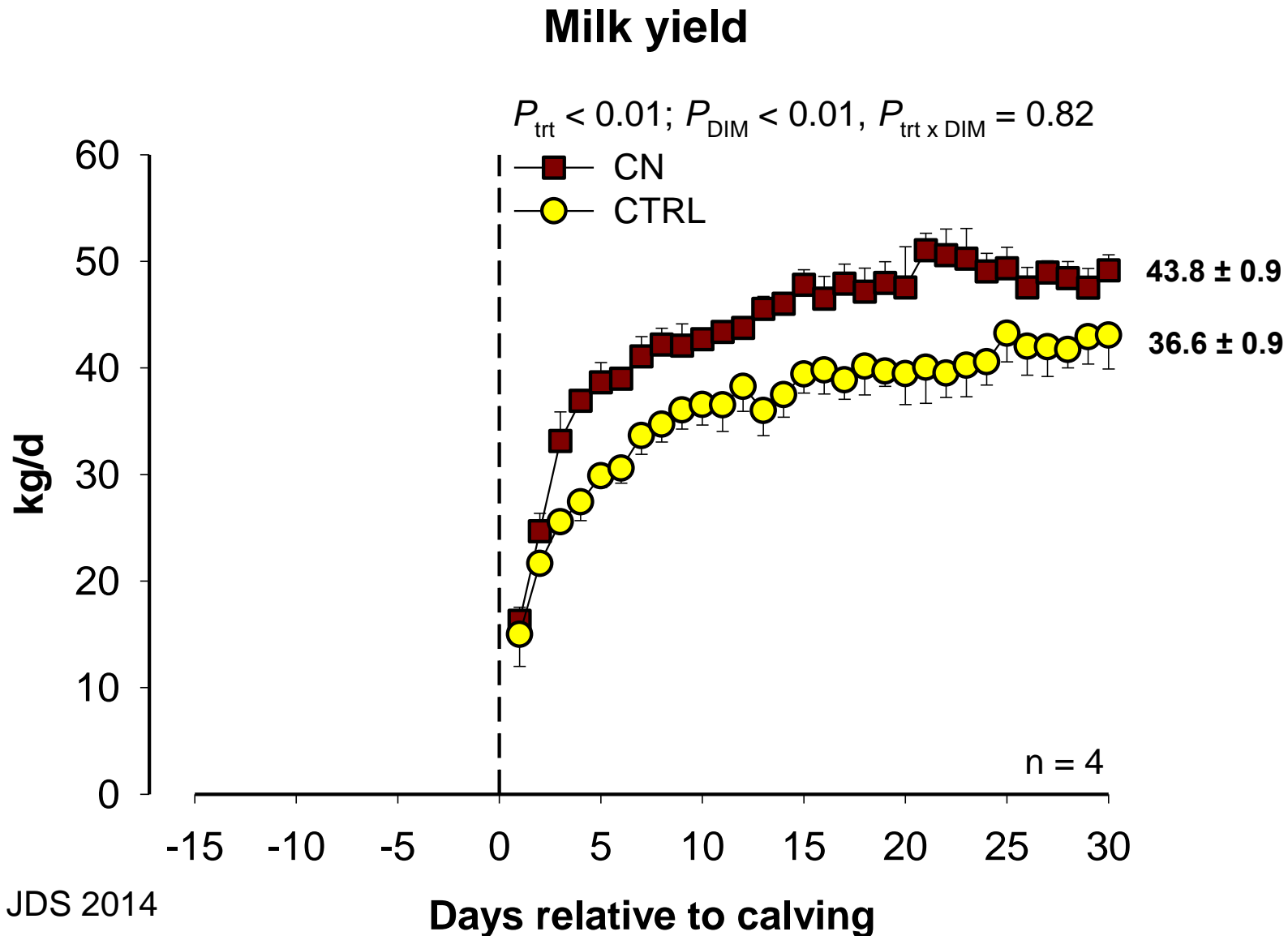
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Amino acid balance is negative first 3 weeks after calving

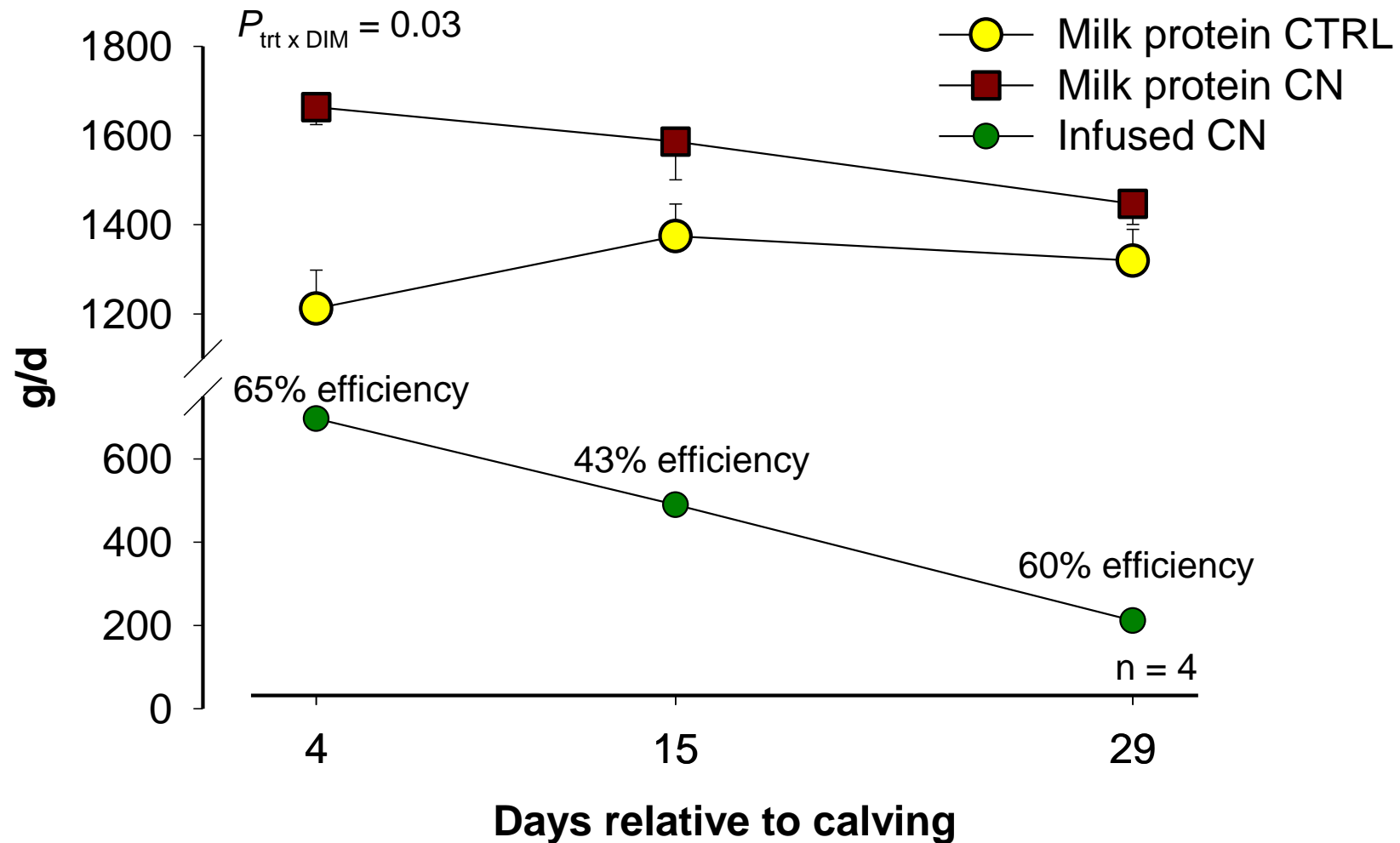


Bell et al., 2000

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 ?

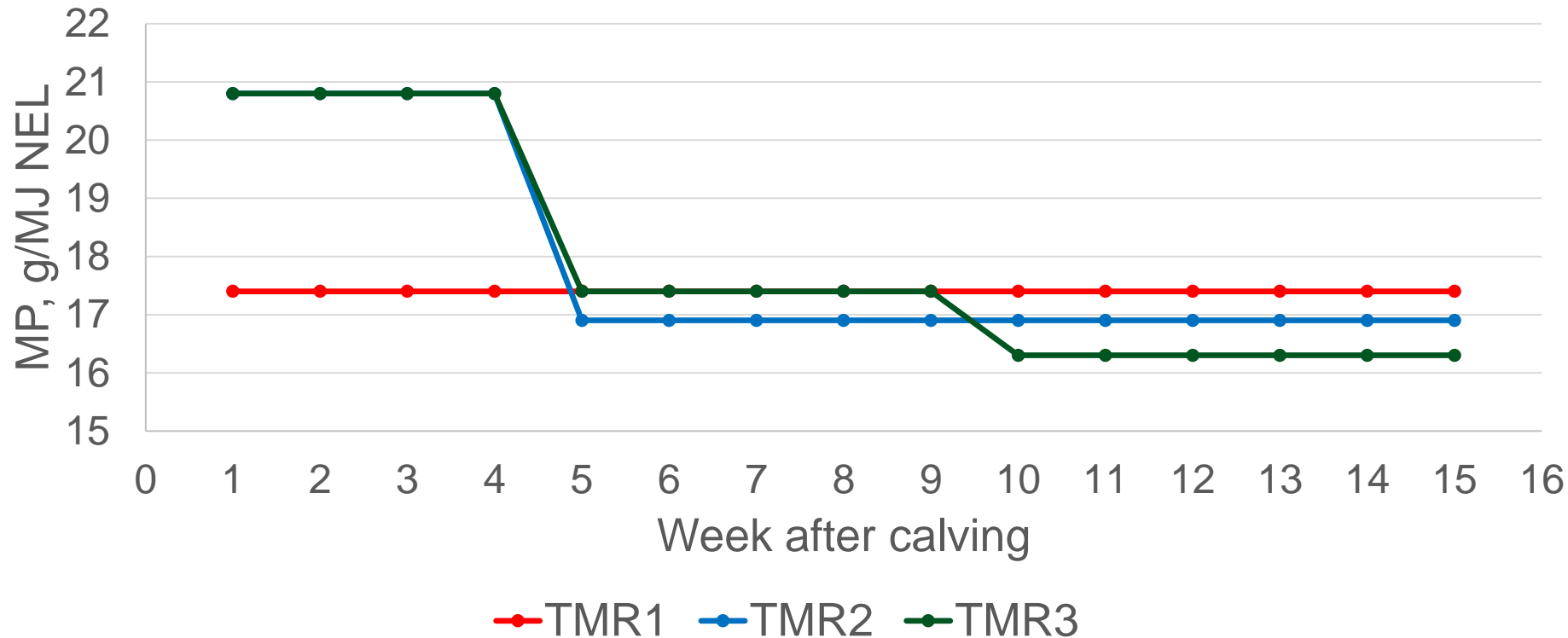
Design

- 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



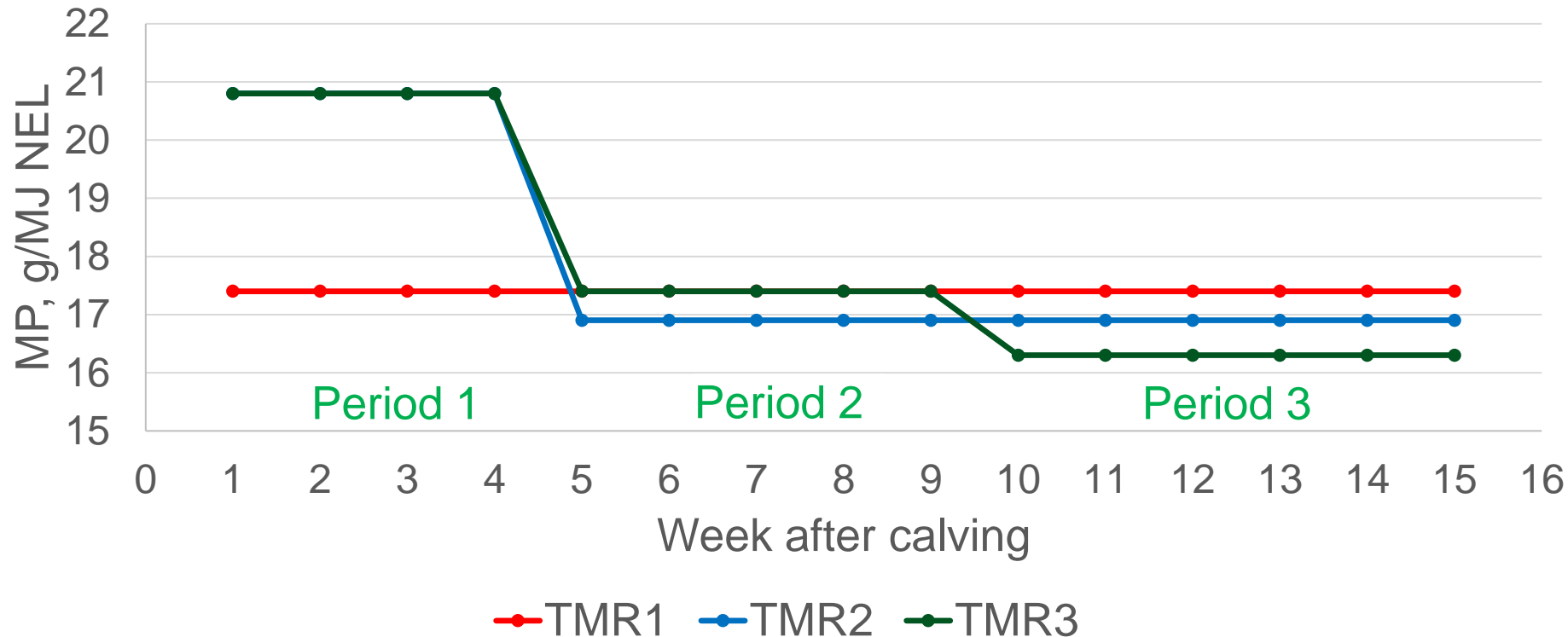
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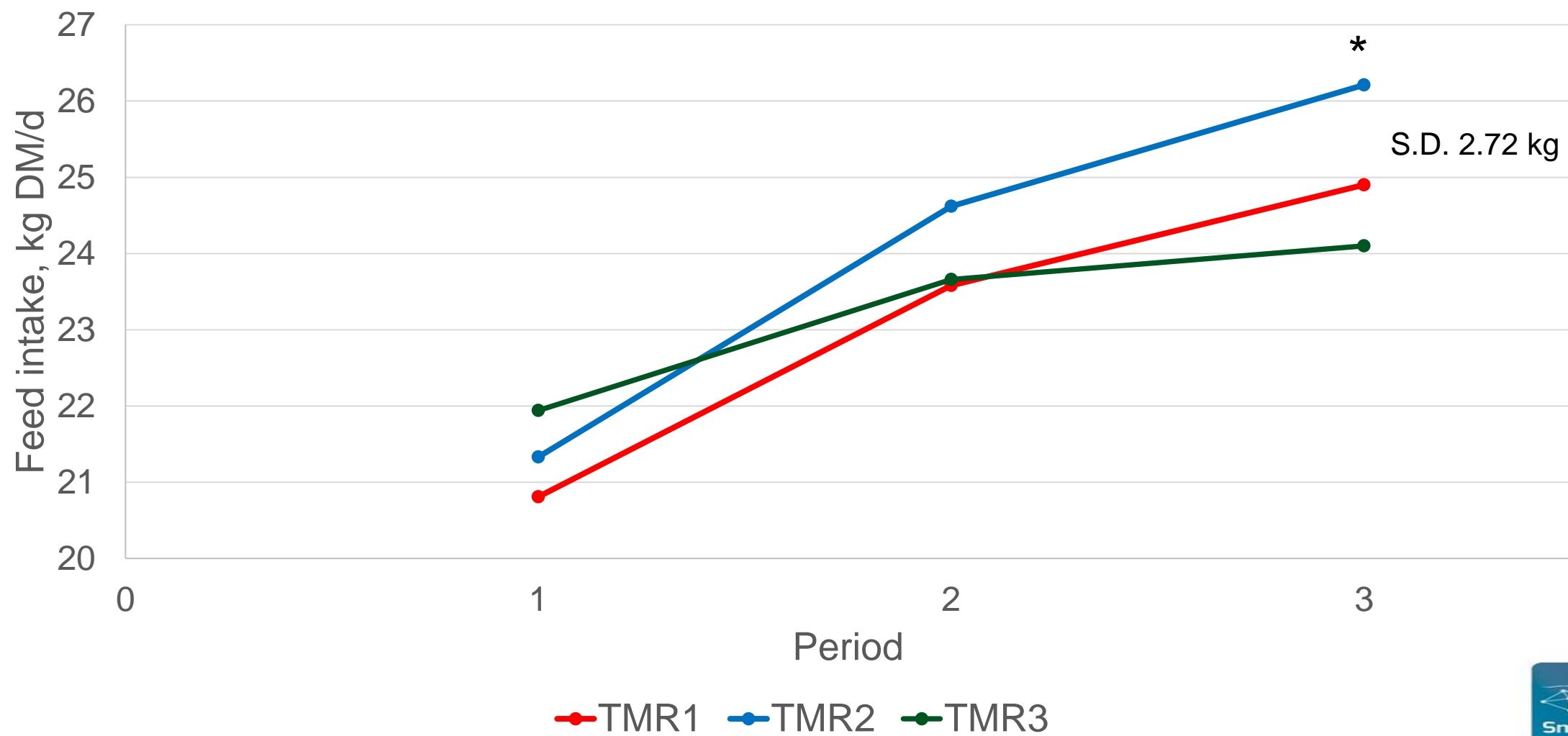


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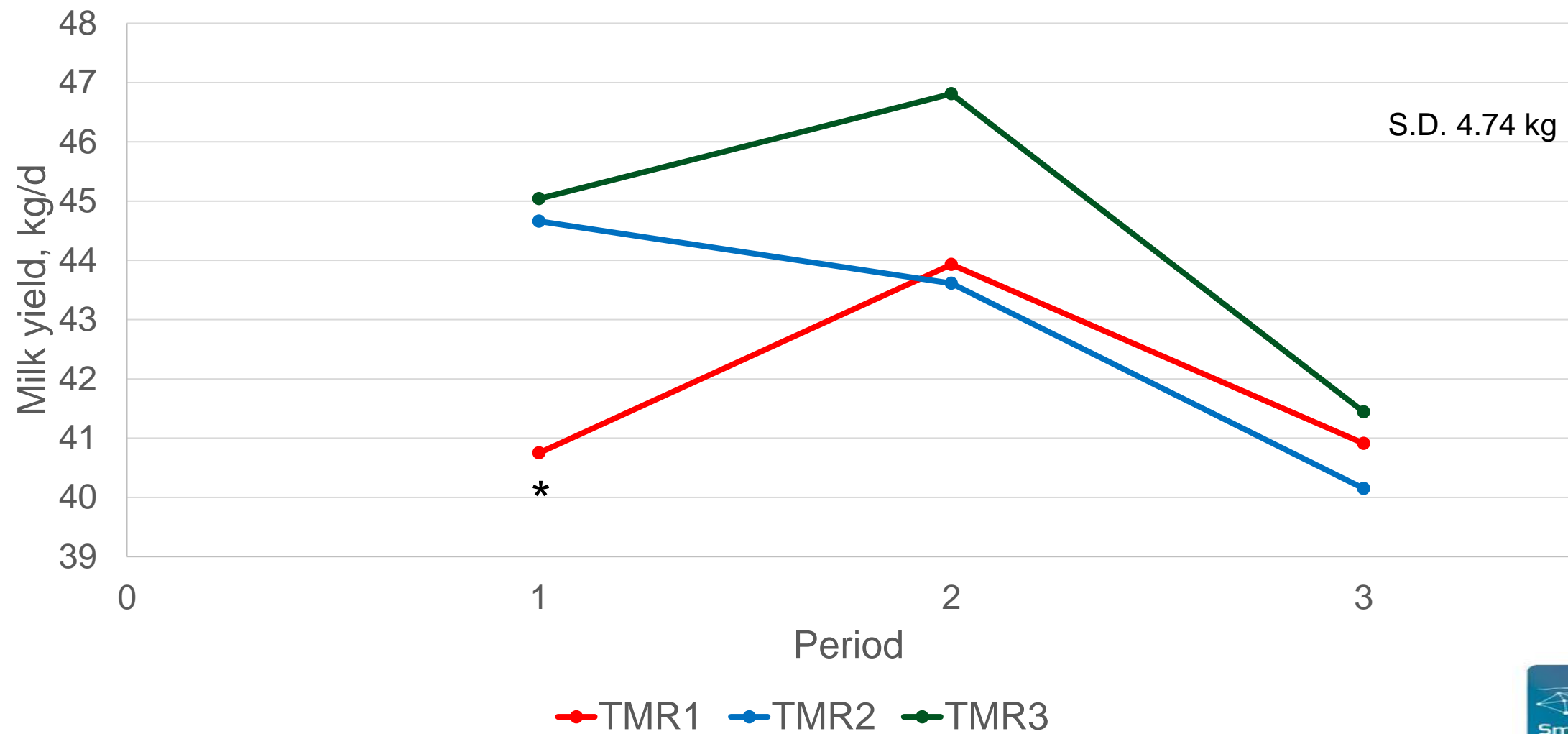
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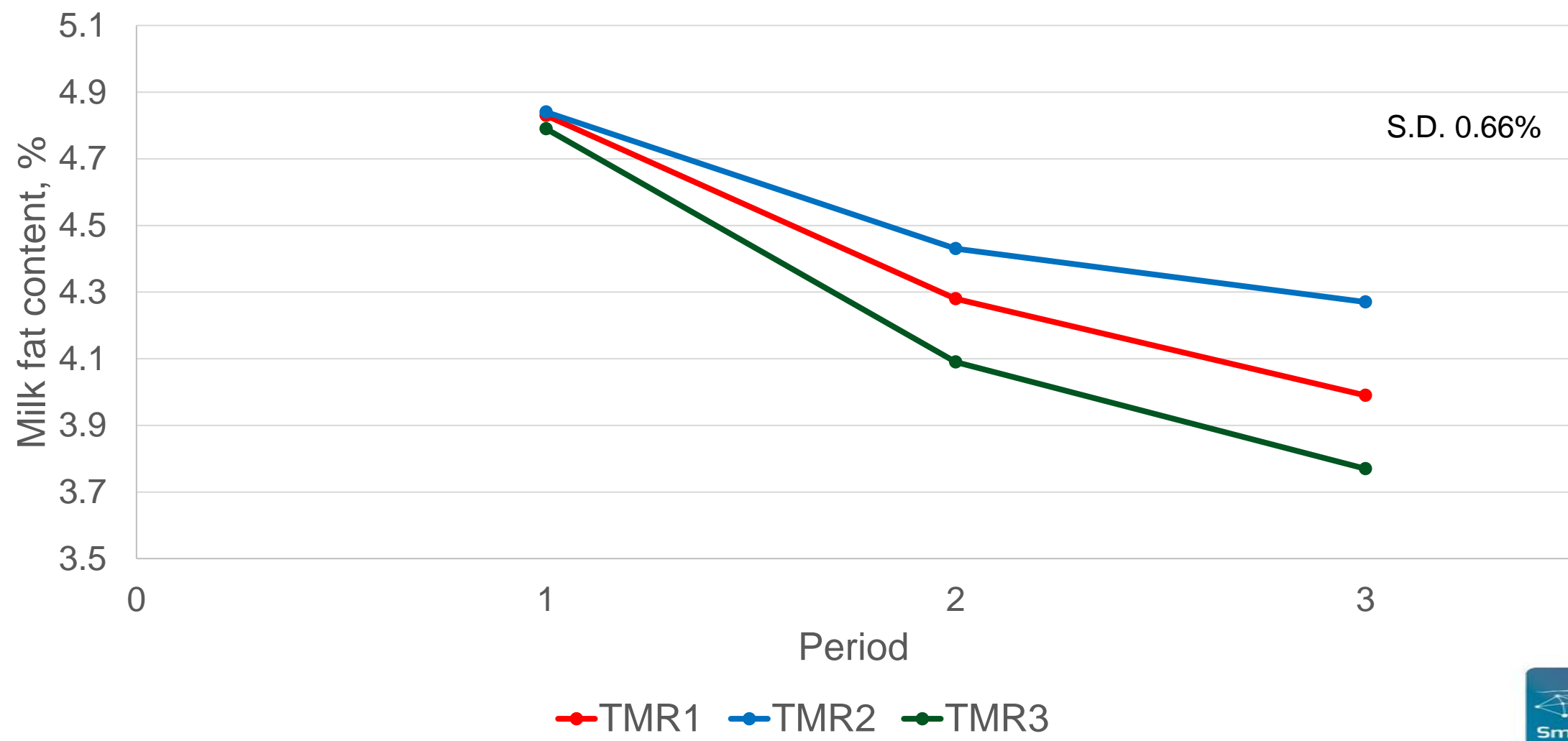
Feed intake



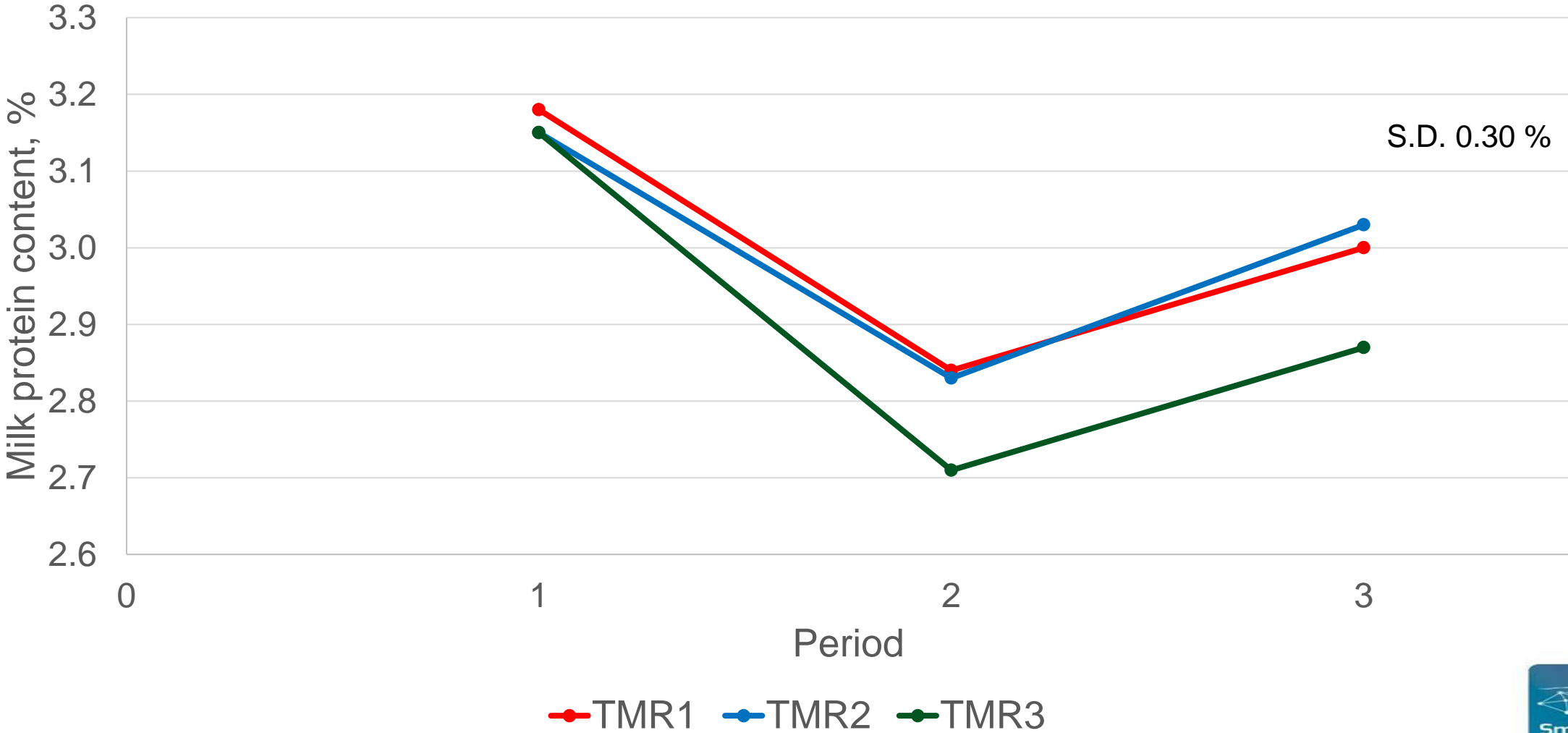
Phase feeding increases MY by 4 kg



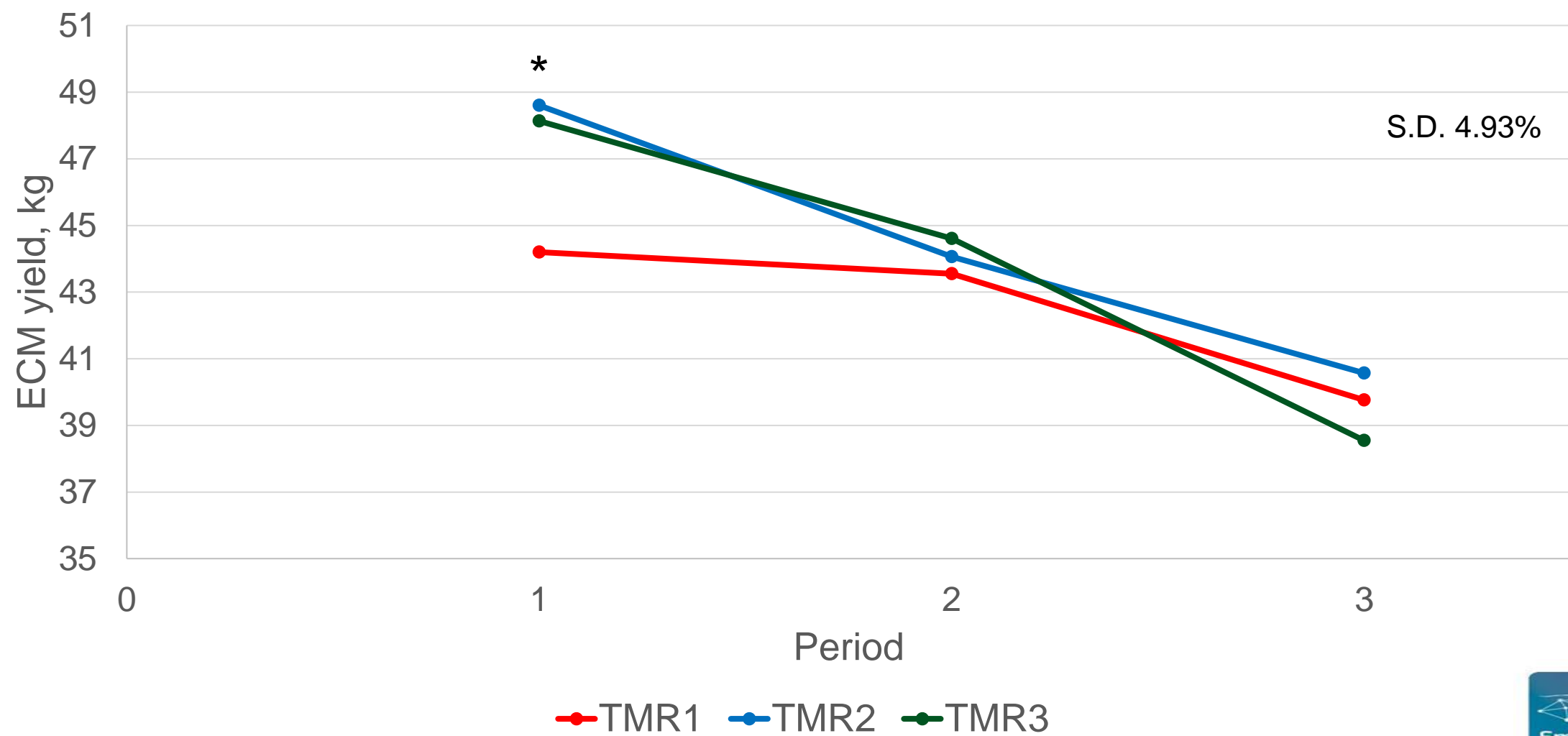
Milk fat



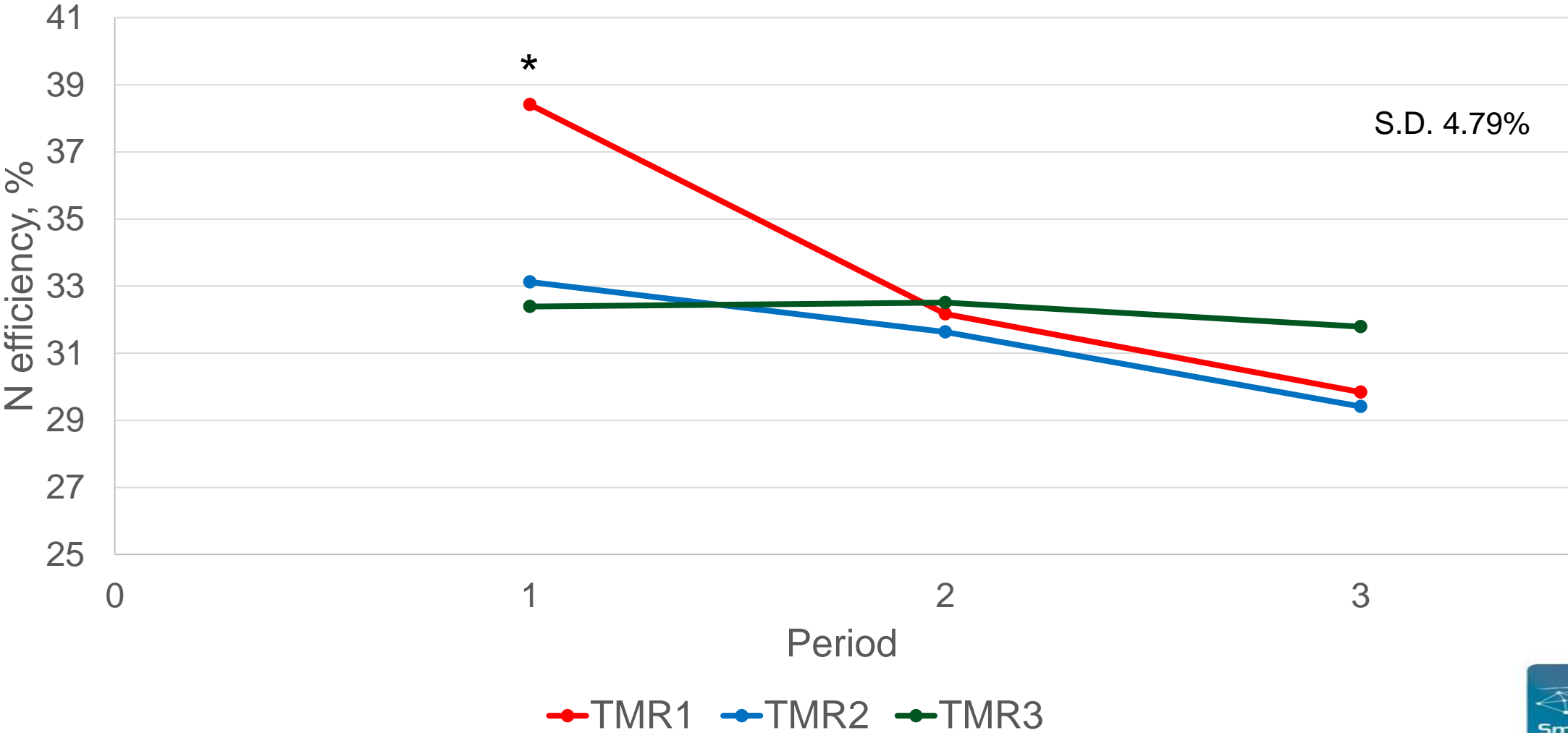
Milk protein



ECM-yield



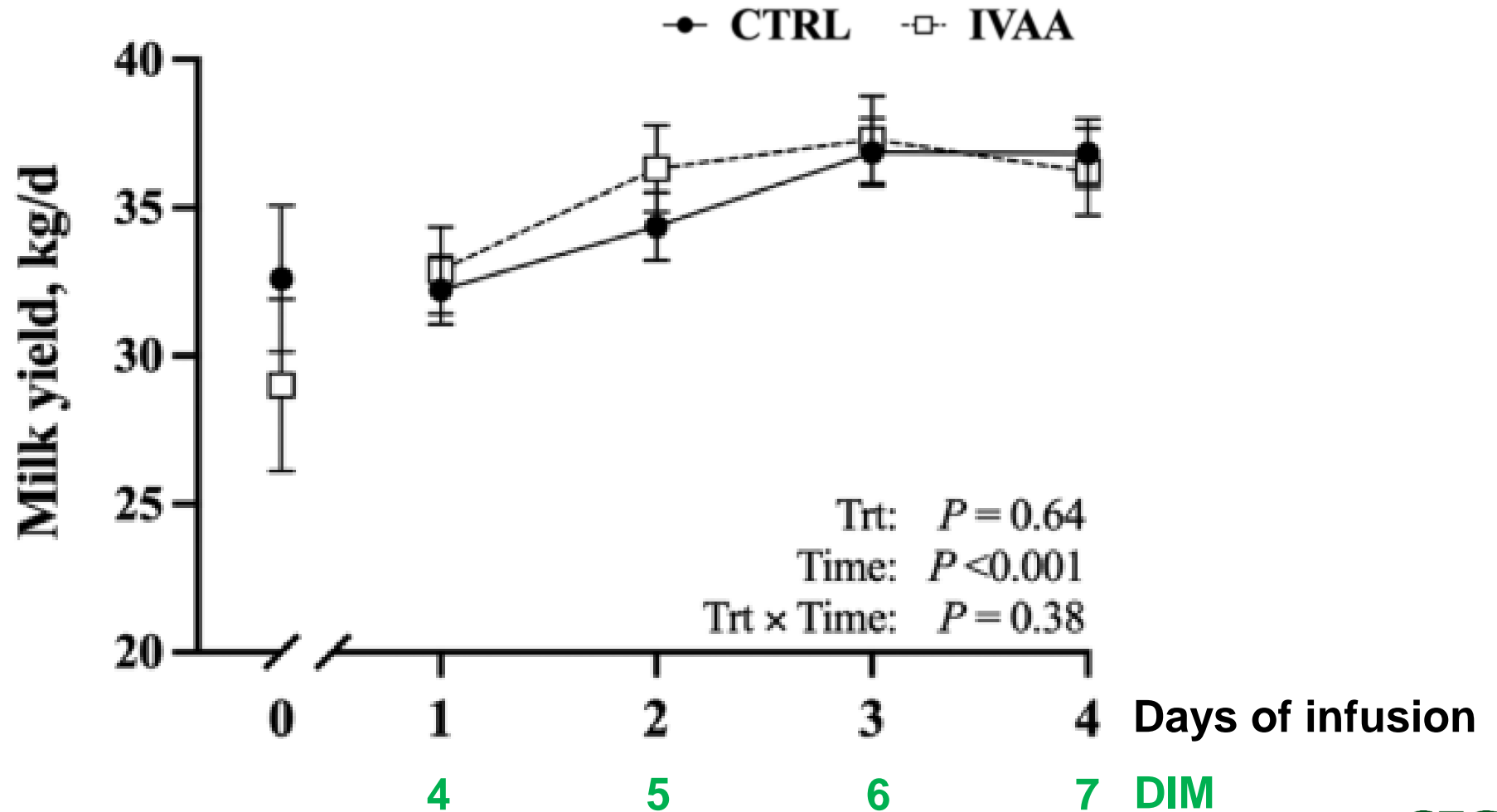
N-efficiency



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 ?



Chandler et al., JDS 2022

Acknowledgements

- Dave Humphries & Chris Reynolds, Reading University



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

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 ?



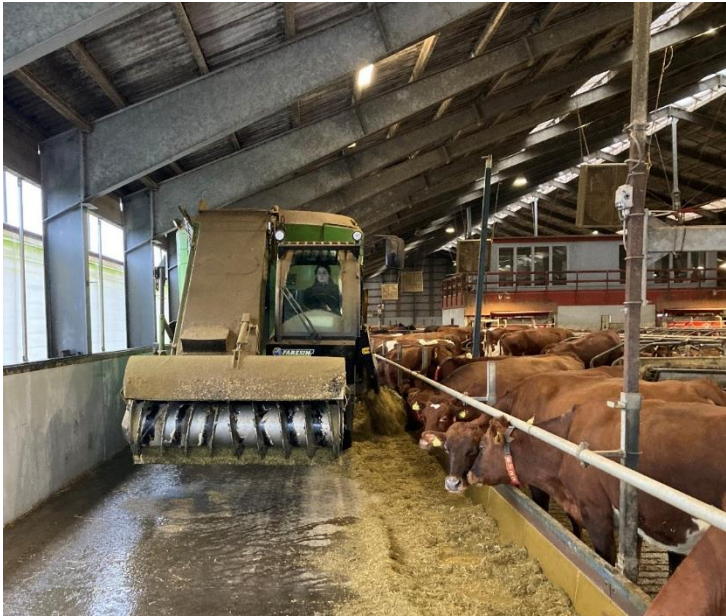
Purpose with test of Bovaer®



- 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



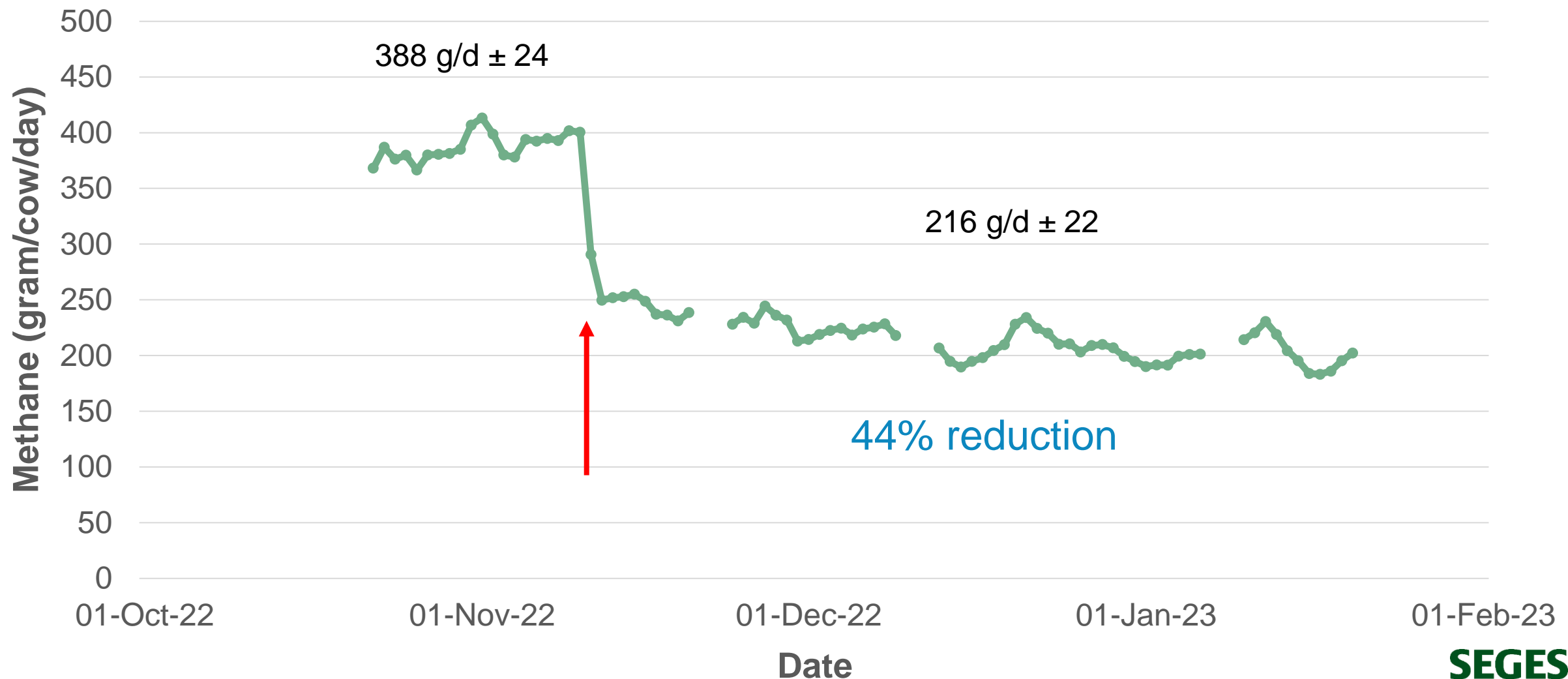
Installation of GreenFeed units in cubicles



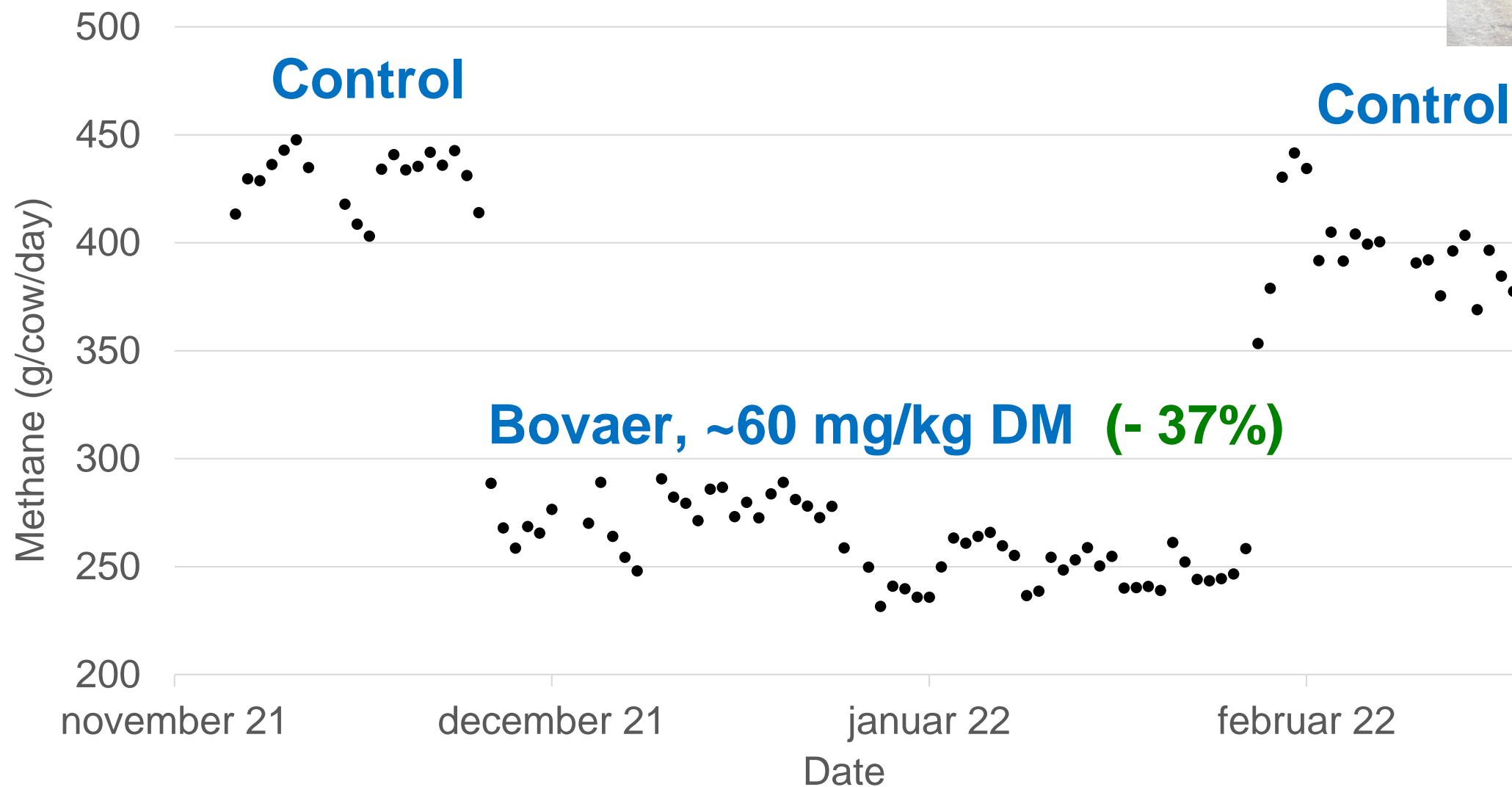
Installation of GreenFeed on slatted floors



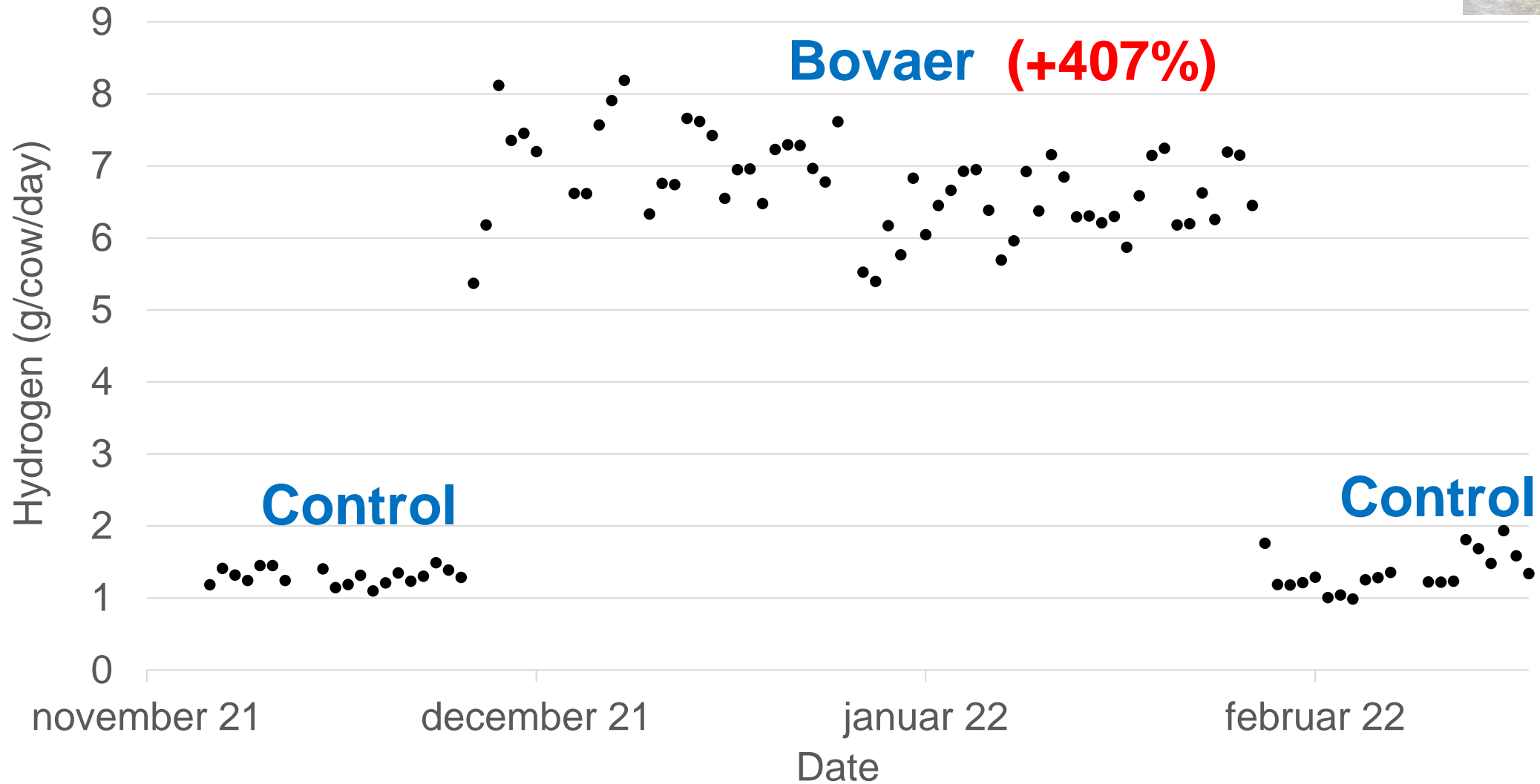
Effect of Bovaer on enteric methane production (n=57 Holstein cows)



Methane (n=36 red cows)



Hydrogen (n=36 red cows)



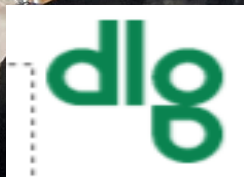
Feed intake and milk production

	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



Thanks to
Dairy Farmers



Supported by
Danish Milk Levy Foundation





Thank you for your attention
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