HOW TO REDUCE ENTERIC METHANE FROM DAIRY COW

P. LUND, C. F. BØRSTING, G. GIAGNONI, M. KJELDSEN, M. LARSEN, M. MAIGAARD, M. O. NIELSEN, D. OLIJHOEK, M. THORSTEINSSON, W. WANG, M. R. WEISBJERG

Peter Lund
Dep. of Animal and Veterinary Sciences
Aarhus University
Peter.Lund@anivet.au.dk

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EAAP, Session 30
Sept 2024, 30 min. incl. questions

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Denmark will be first to impose CO2 tax on farms, government says

By Isabelle Yr Carlsson

June 25, 2024 12:30 PM GMT+2 · Updated 2 months ago

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Danish farmers concerned carbon tax will lead to lower production

By Isabelle Yr Carlsson

February 21, 2024 6:24 PM GMT+1 · Updated 3 months ago

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2030: 16 €/t CO_2-eq; 2035: 40 €/t CO_2-eq

TOP 5 CONTRIBUTORS TO DANISH AGRI GHG

1. Enteric fermentation, mainly from ruminants, CH_4 (33%)

2. Manure management, CH_4 (20%)

3. Inorganic N fertilizer, N_2O (10%)

4. Manure on soil, N_2O (9%)

5. Crop residues, N_2O (8%)

Nielsen et al. (2022)

ADDITIONAL INITIATIVE – DAIRY COWS

As of January 2025:

- Option 1: Increase the level of fatty acids in the diet to 48 g FA/kg DM
- Option 2: Use Bovaer (60 mg/kg DM) for 3 month per year

Full economical compensation for the first 2 years

Mandatory, except for organic farms and farms with less than 50 dairy cows

THE LOW HANGING FRUITS

Significant effect

Consistent effect

Persistent effect

High TRL level

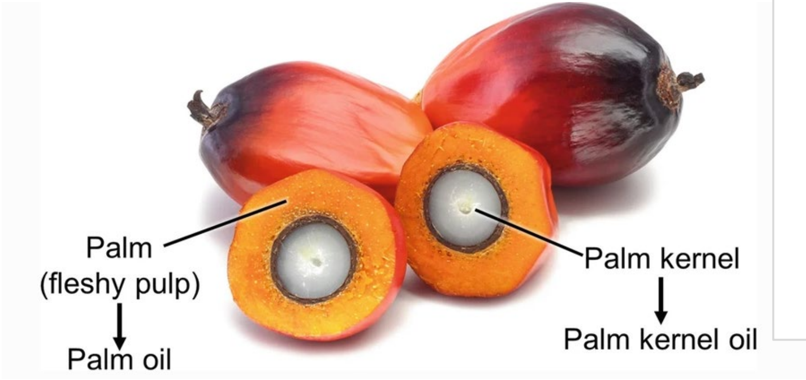
Minor neg. trade-offs

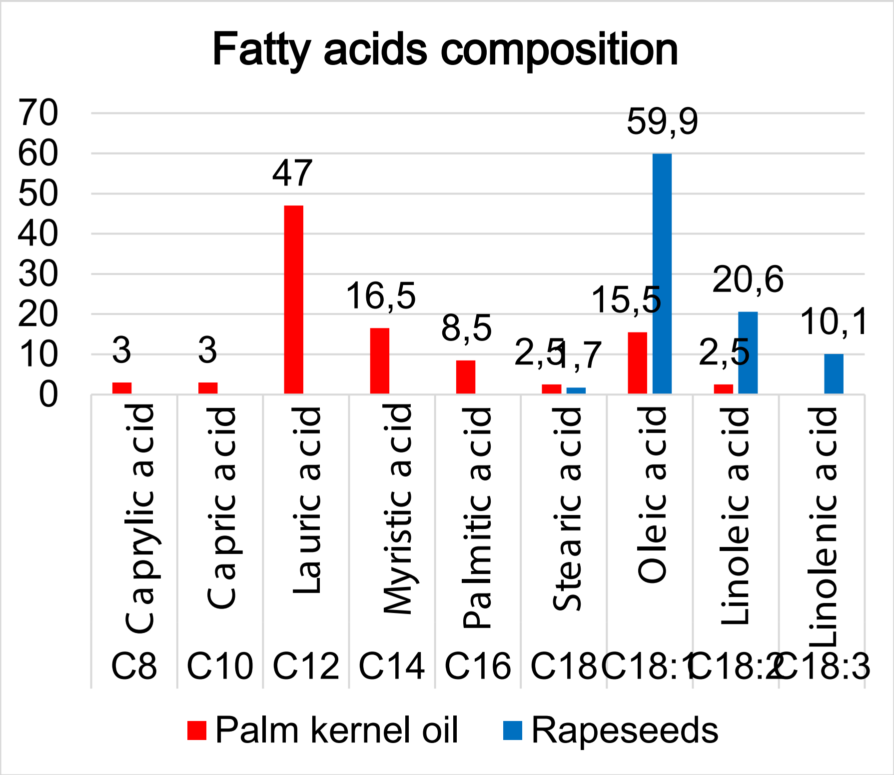
Fat supplementation
10%

Bovaer (3-NOP)
30%

Nitrate
10%

FATTY ACID PROFILE





Giagnoni et al. (2022)

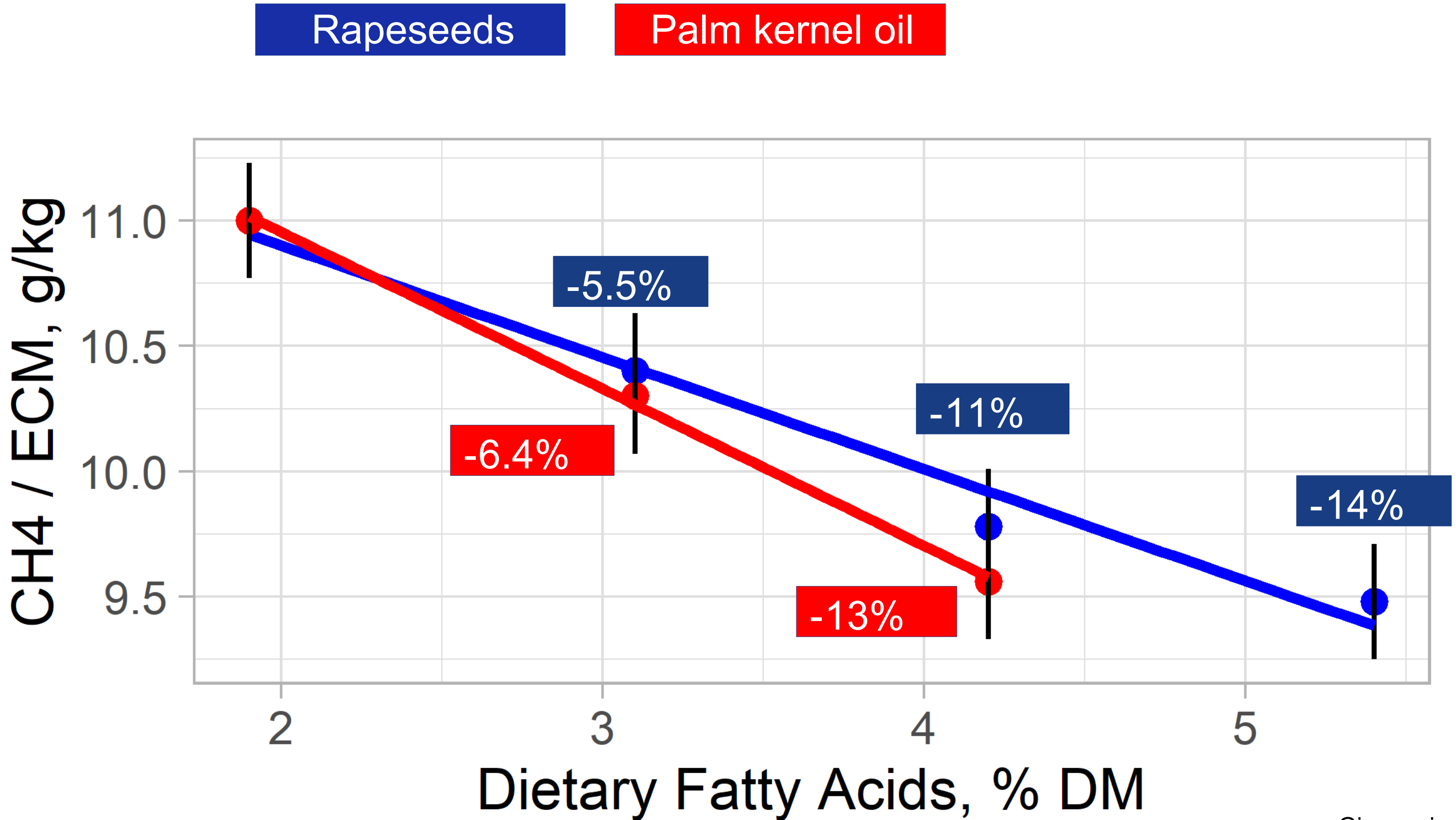
DIETS

1.9% FA 3.1% fat	3.0% FA 4.4% fat	4.2% FA 5.6% fat	5.4% FA 6.9% fat
Control	Rapeseeds	Rapeseeds	Rapeseeds
	Palm kernel oil	Palm kernel oil	

Ingredient, %DM	Basal diet
- Spring barley	19.5
- Grass-clover Silage	39.0
- Maize silage	31.2
- Beet pulp, dried	7.80
- Sodium bicarbonate	1.63
- Mineral and vitamins	0.65

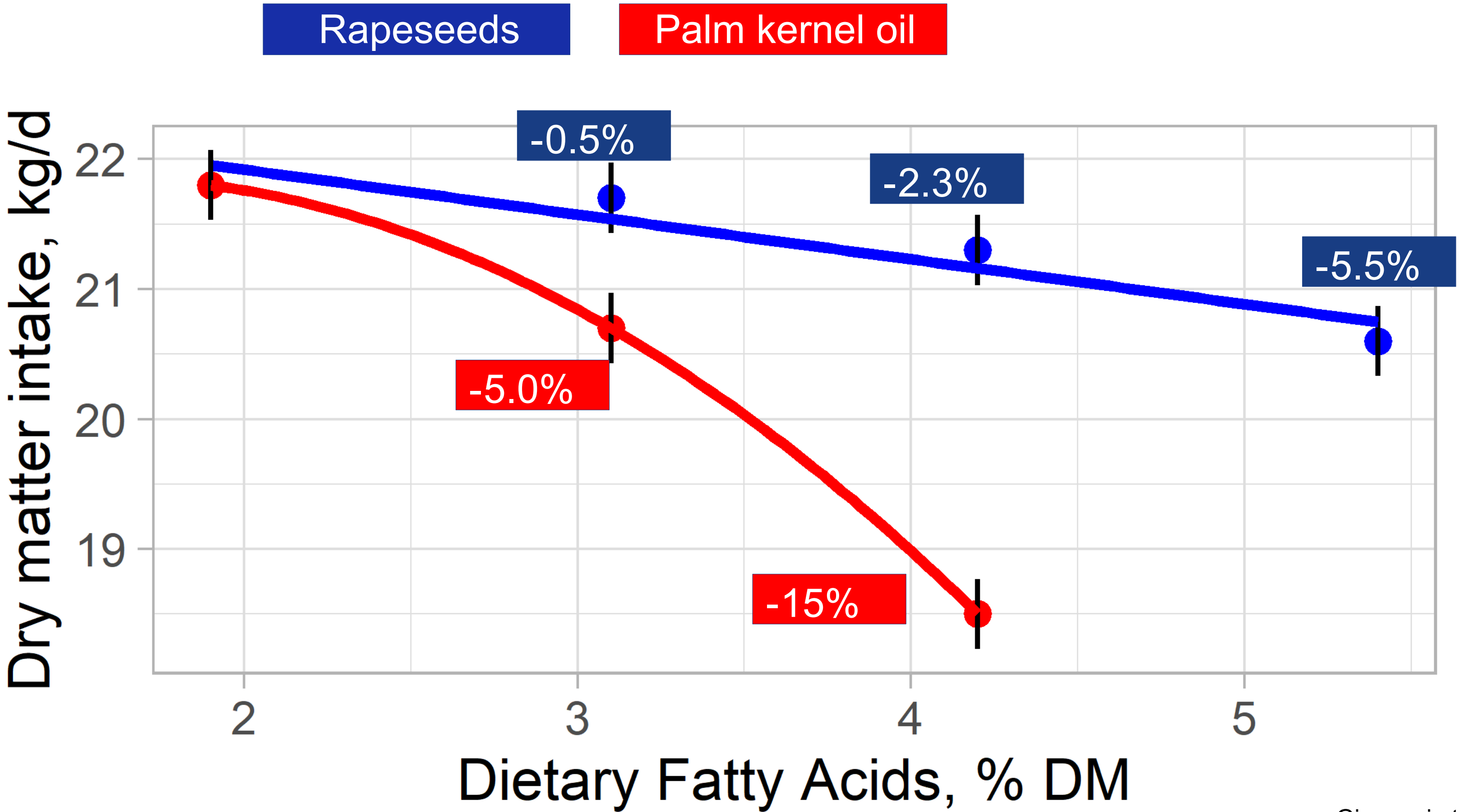
Giagnoni et al. (2022)

METHANE, G/KG ECM



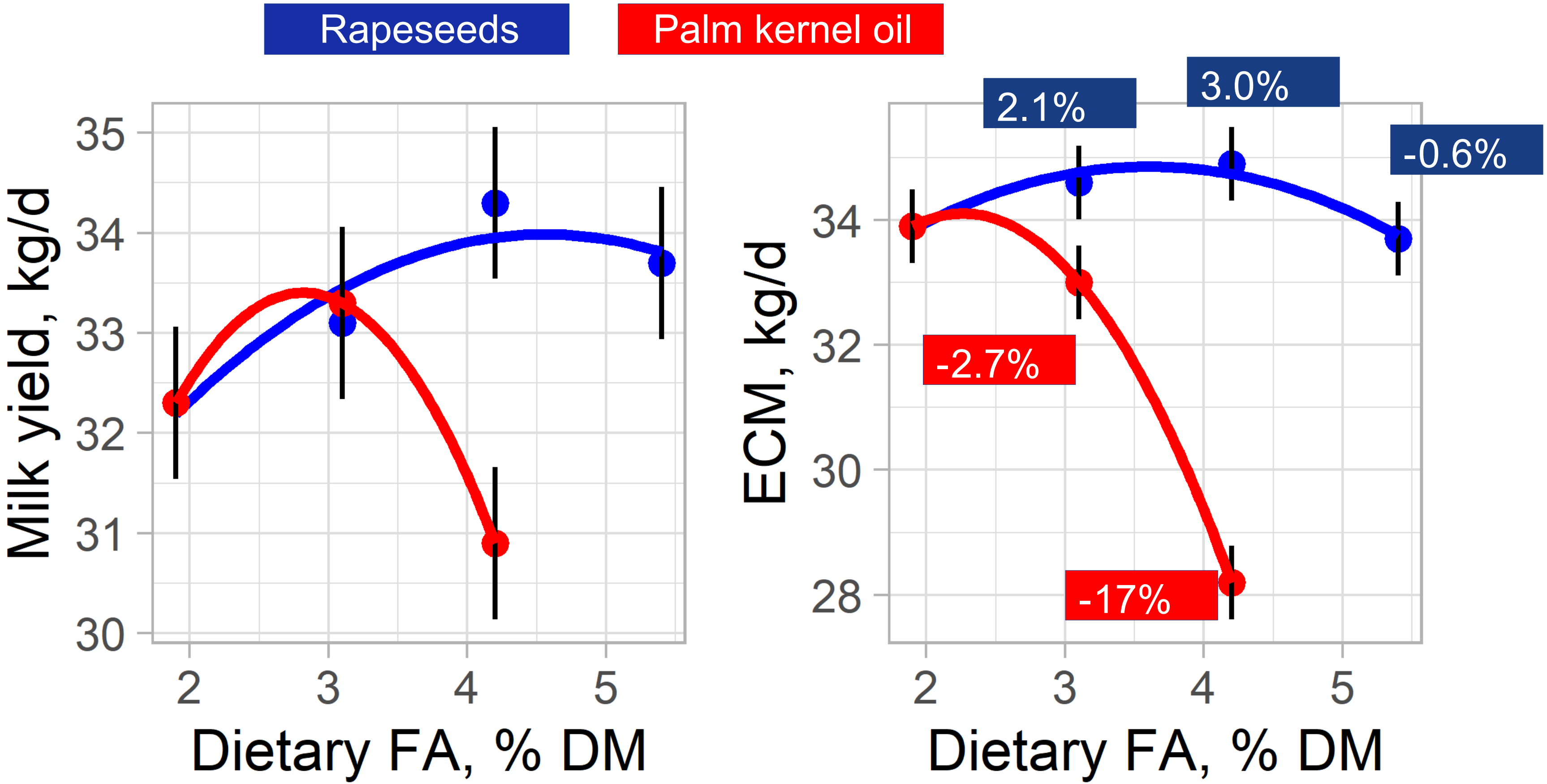
Giagnoni et al. (2022)

FEED INTAKE



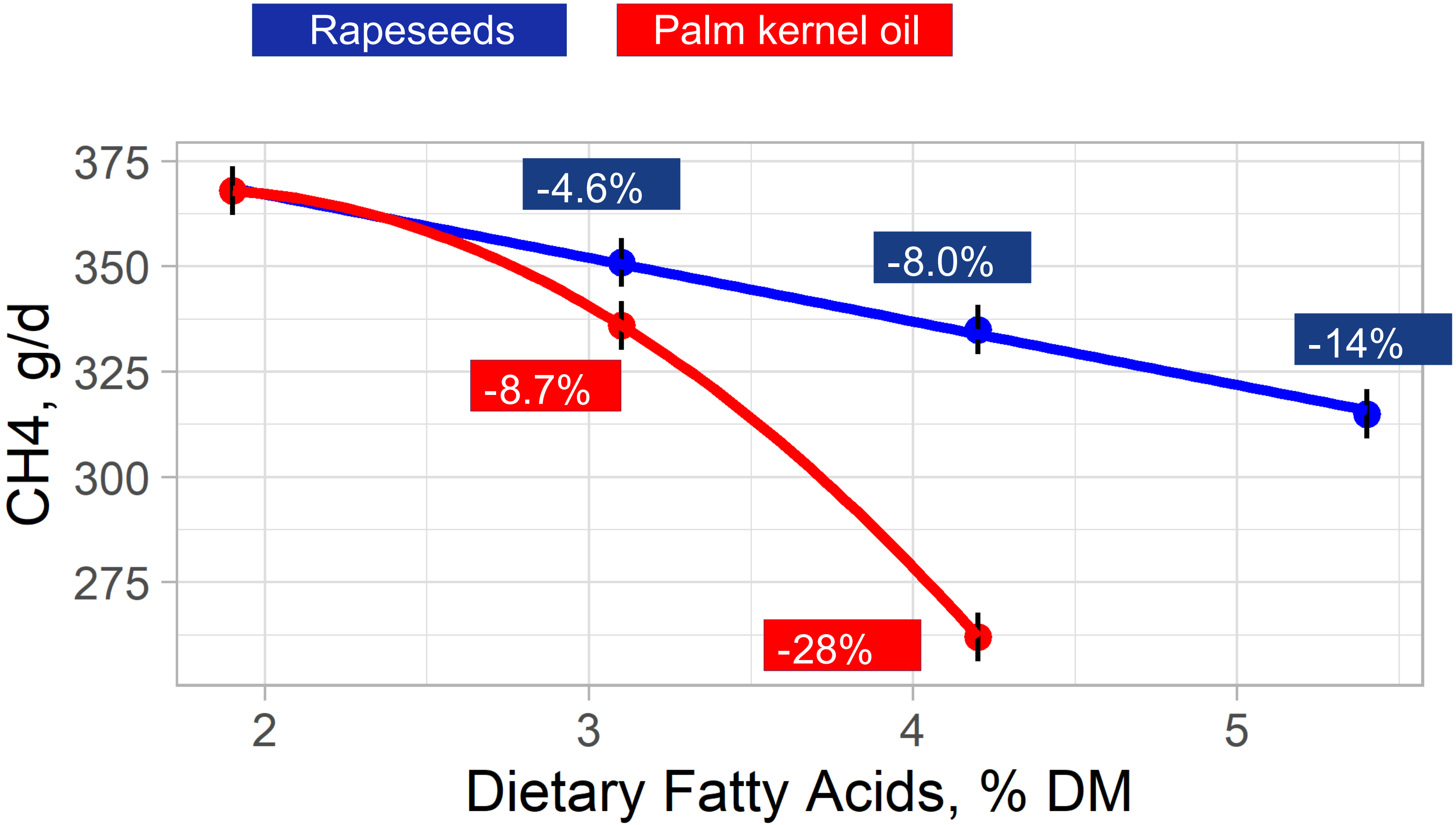
Giagnoni et al. (2022)

MILK YIELD



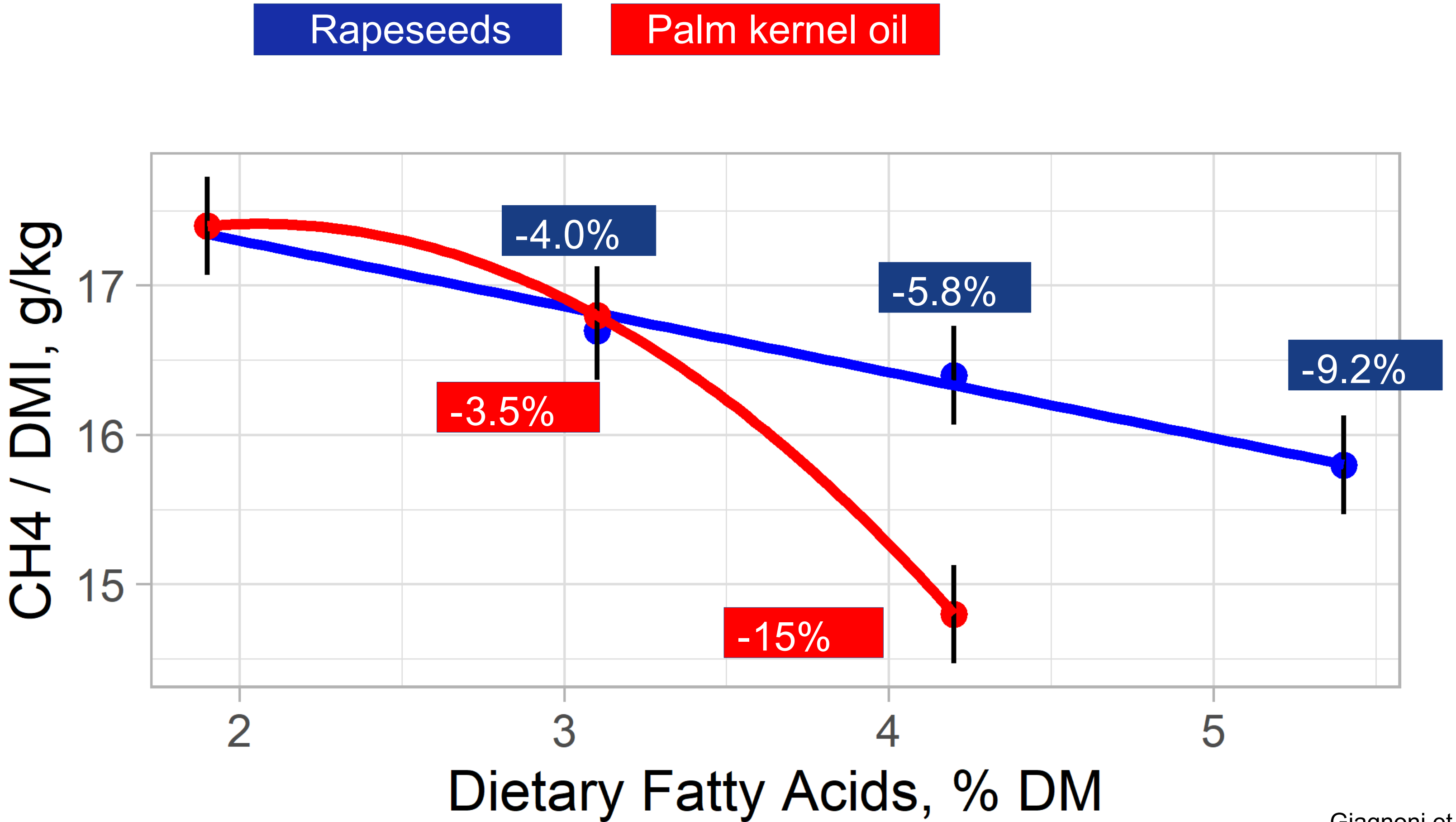
Giagnoni et al. (2022)

METHANE EMISSION



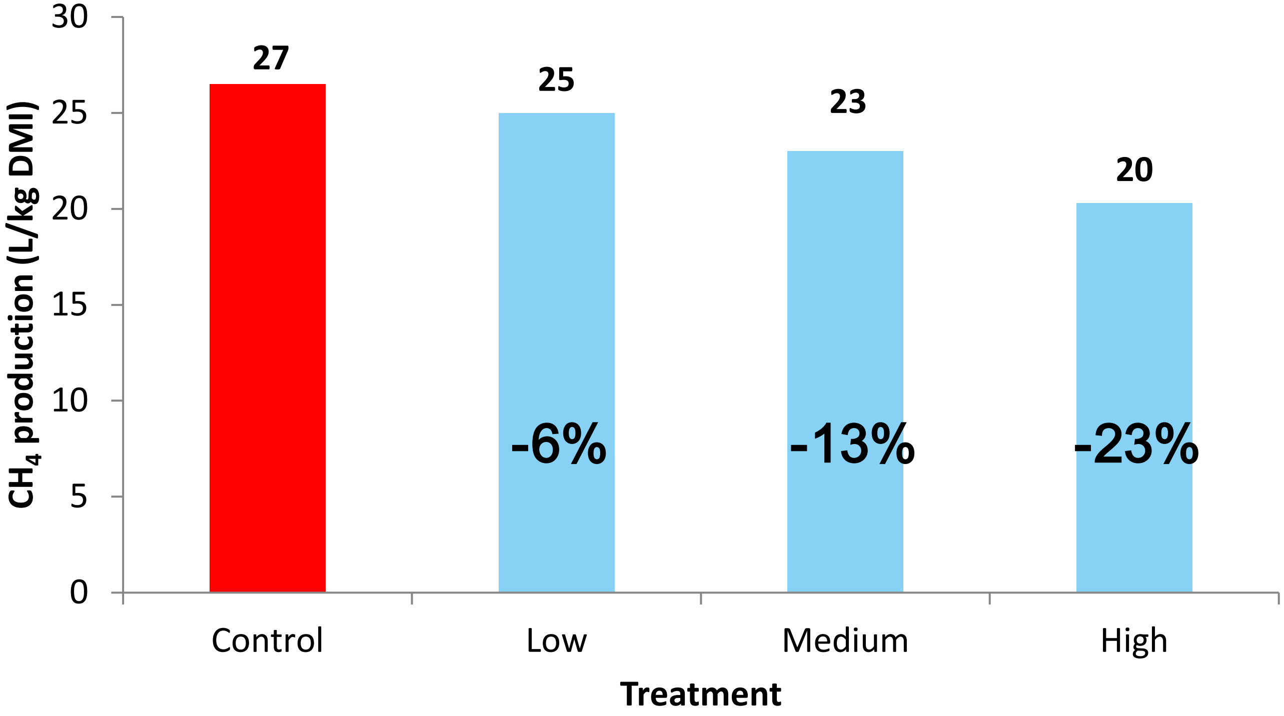
Giagnoni et al. (2022)

METHANE YIELD, G/KG DM



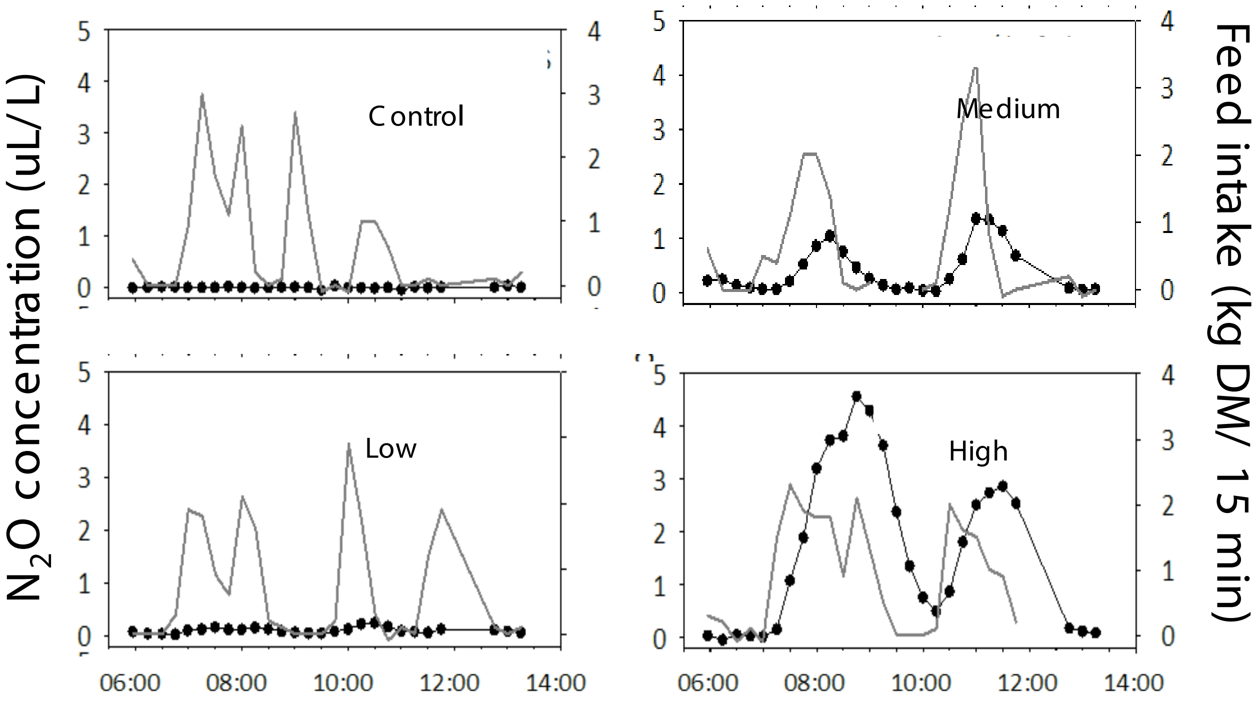
Giagnoni et al. (2022)

NITRATE – DUAL PURPOSE ADDITIVE



Olijhoek et al. (2016)

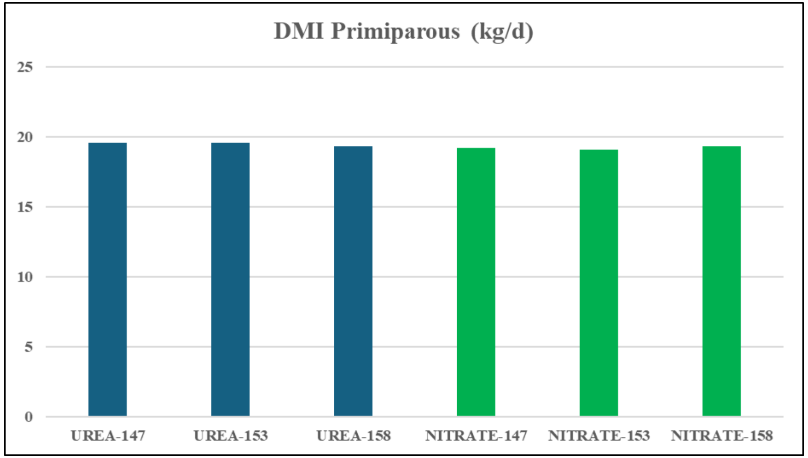
N_2O (256 X CO_2)



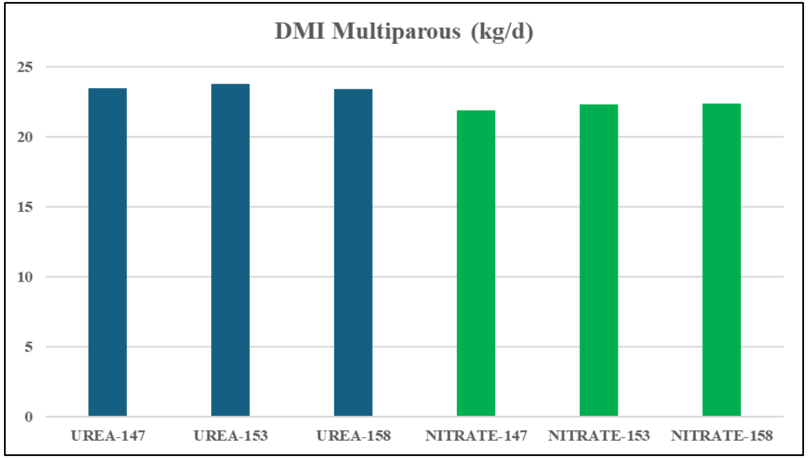
Petersen et al. (2015)

NITRATE – PRODUCTION STUDY

10 g Nitrate/kg DM: -2% in DM intake



10 g Nitrate/kg DM: -6% in DM intake

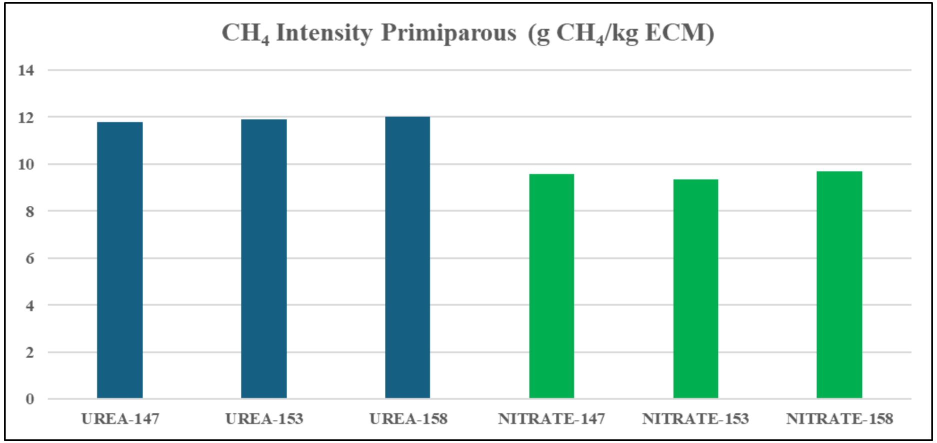


147: 147 g CP/kg DM
153: 153 g CP/kg DM
158: 158 g CP/kg DM

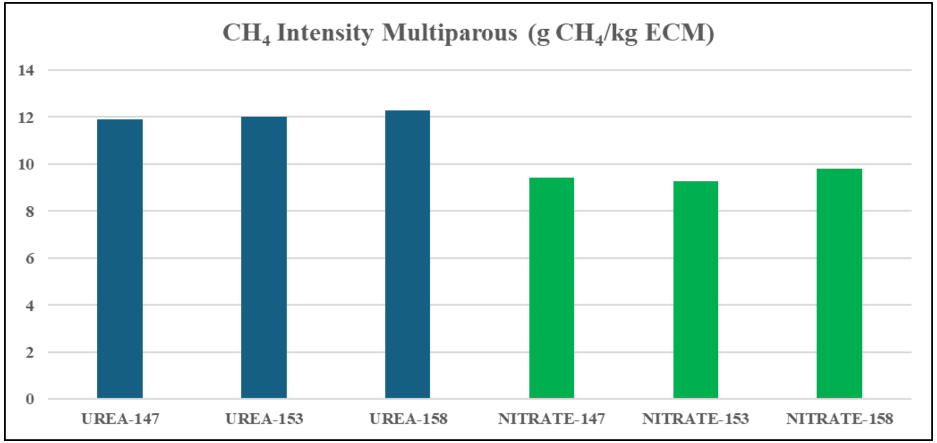
Wang et al. (2024)

NITRATE – PRODUCTION STUDY

10 g Nitrate/kg DM: -20 % in CH_4 intensity



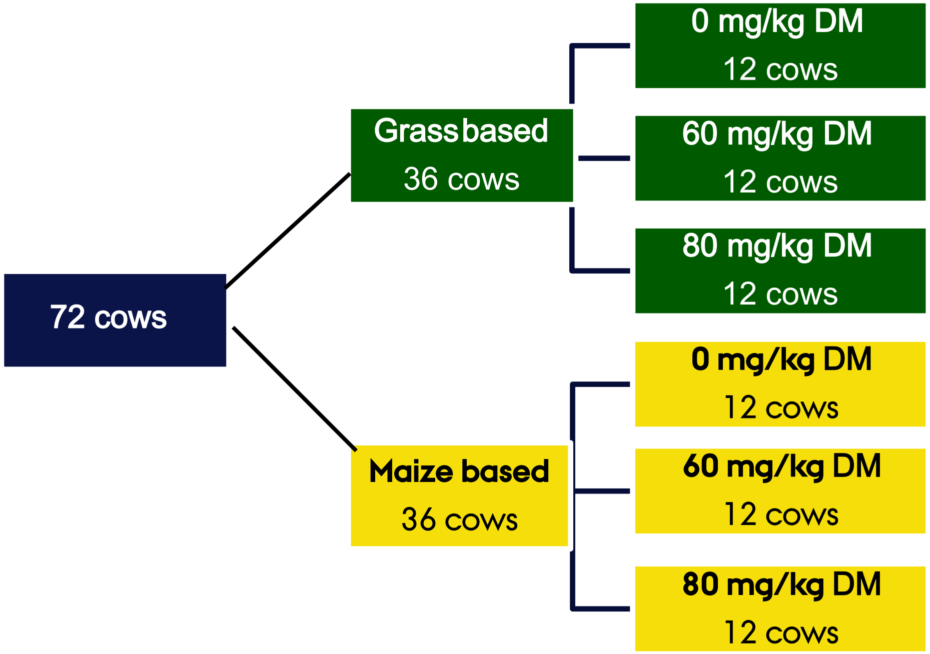
10 g Nitrate/kg DM: -21 % in CH_4 intensity



147: 147 g CP/kg DM
153: 153 g CP/kg DM
158: 158 g CP/kg DM

Wang et al. (2024)

BOVAER XFORAGETYPE



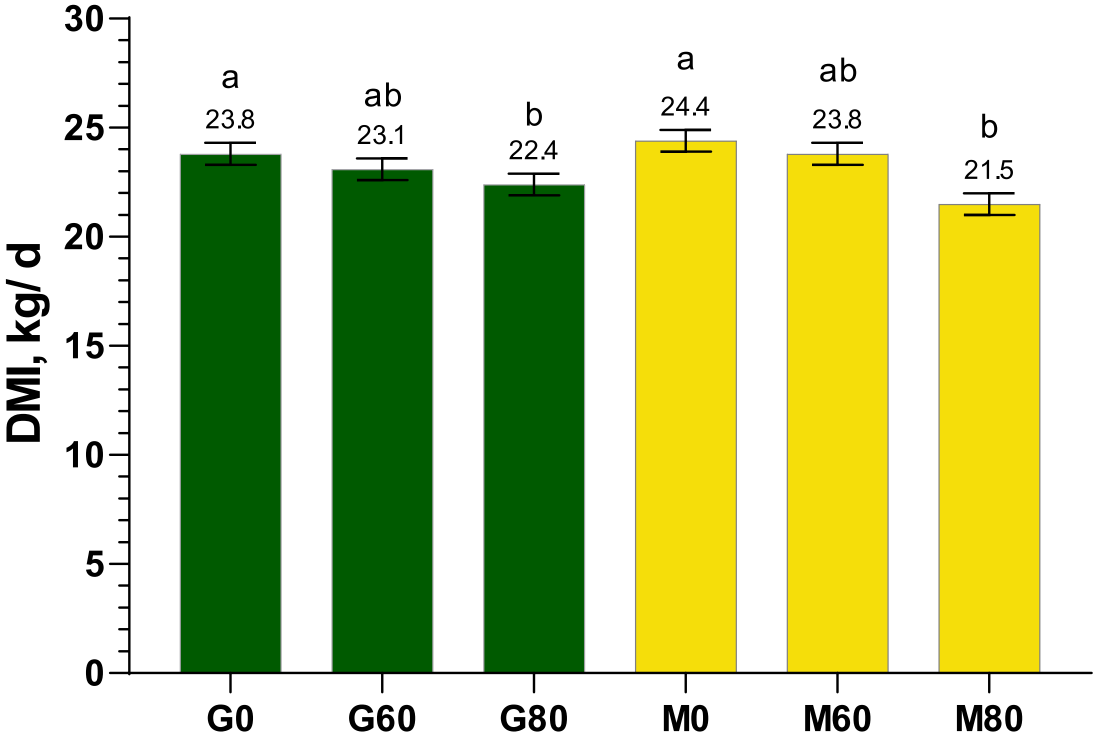
Maigaard et al. (2024)

THE DIETS WERE SIMILAR IN FIBER, STARCH, AND FAT

	Grass-based 60:40 Grass:Maize		Maize-based 40:60 Grass:Maize
Energy, MJ/kg DM	6.5		6.5
Ash, g/kg DM	69		64
Crude protein, g/kg DM	164		161
NDF, g/kg DM	330		331
Starch, g/kg TS	185		194
Crude fat, g/kg TS	43		39

Maigaard et al. (2024)

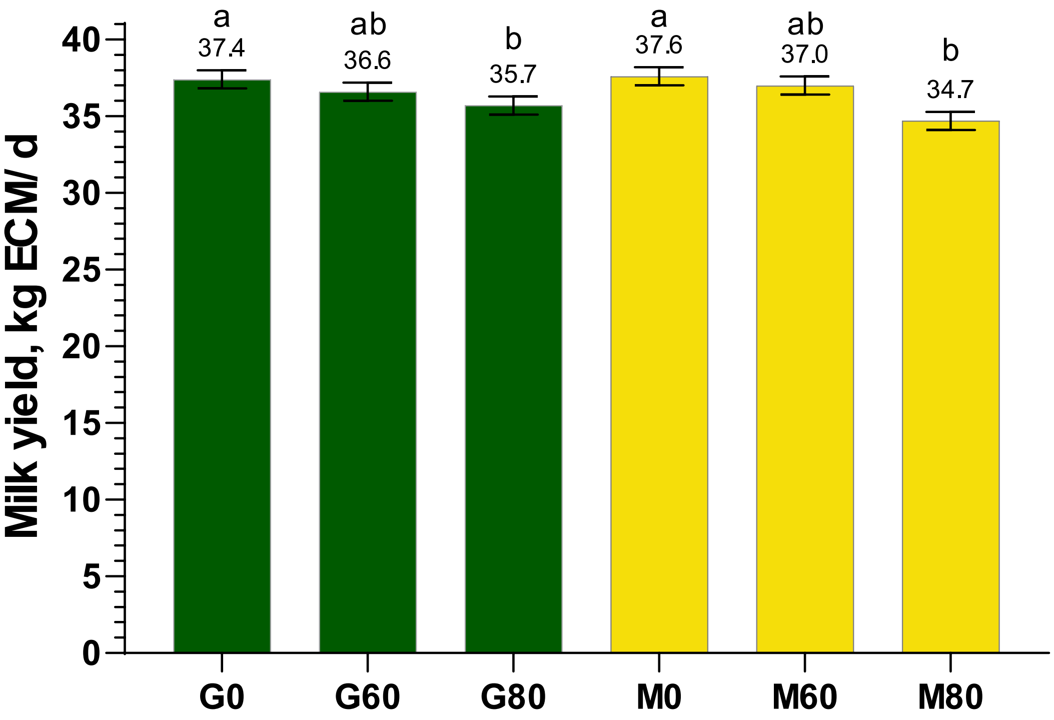
3-NOP AT 80 MG REDUCED DMI BY 9% NO EFFECT OF 60 MG



	P-value
Forage type	0.68
3-NOP dose	<0.01
Week	<0.01
Parity	<0.01
Forage type × 3-NOP	0.22
Forage type × 3-NOP × Week	<0.01

Maigaard et al. (2024)

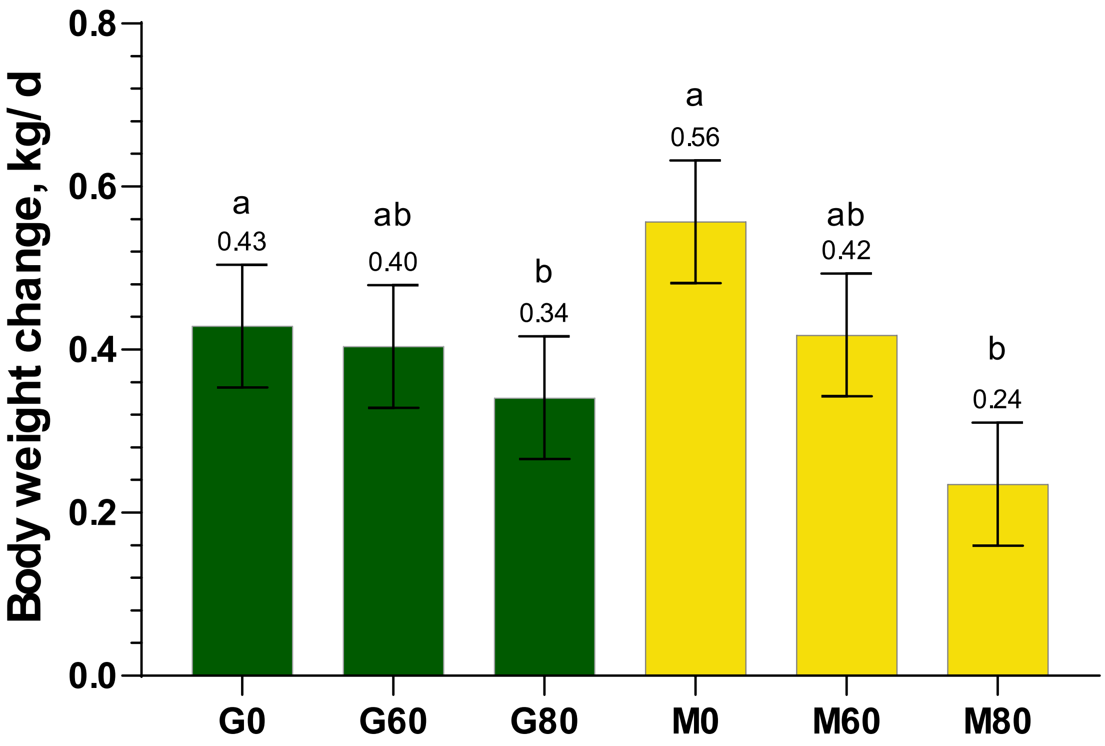
MILKPRODUCTION REDUCED BY 5% AT 80 MG
NO EFFECT OF 60 MG



	P-value
Forage type	0.81
3-NOP dose	<0.01
Week	<0.01
Parity	<0.01
Forage type × 3-NOP	0.39
Forage type × 3-NOP × Week	0.18

Maigaard et al. (2024)

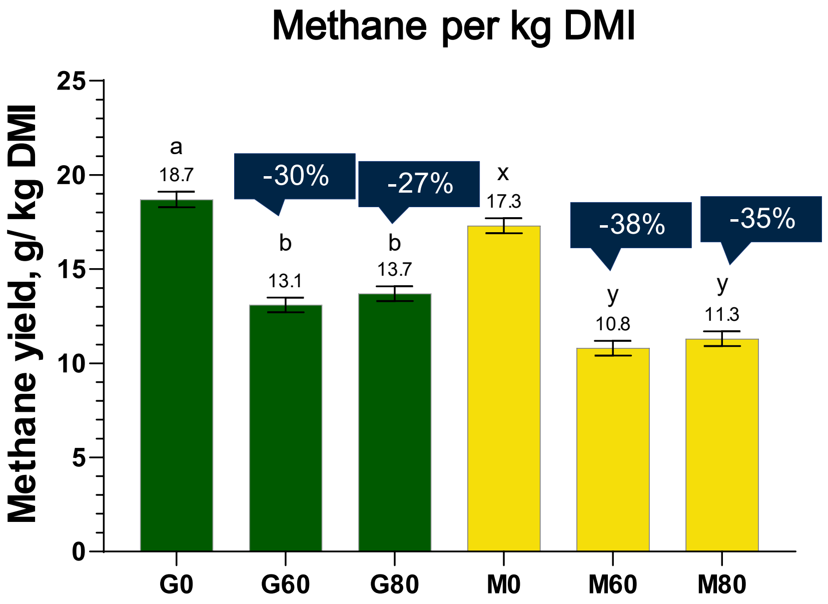
CHANGE OF BW OVER THE 12 WEEKS

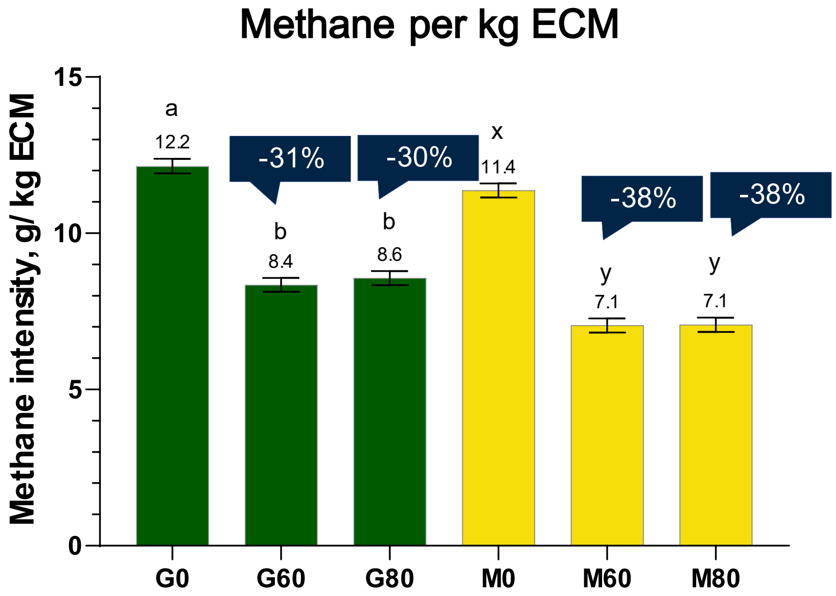


	P-value
Forage type	0.84
3-NOP dose	0.02
Parity	0.48
Forage type × 3-NOP	0.26

Maigaard et al. (2024)

60 & 80 MG 3-NOP ISEQUALLYEFFICIENT





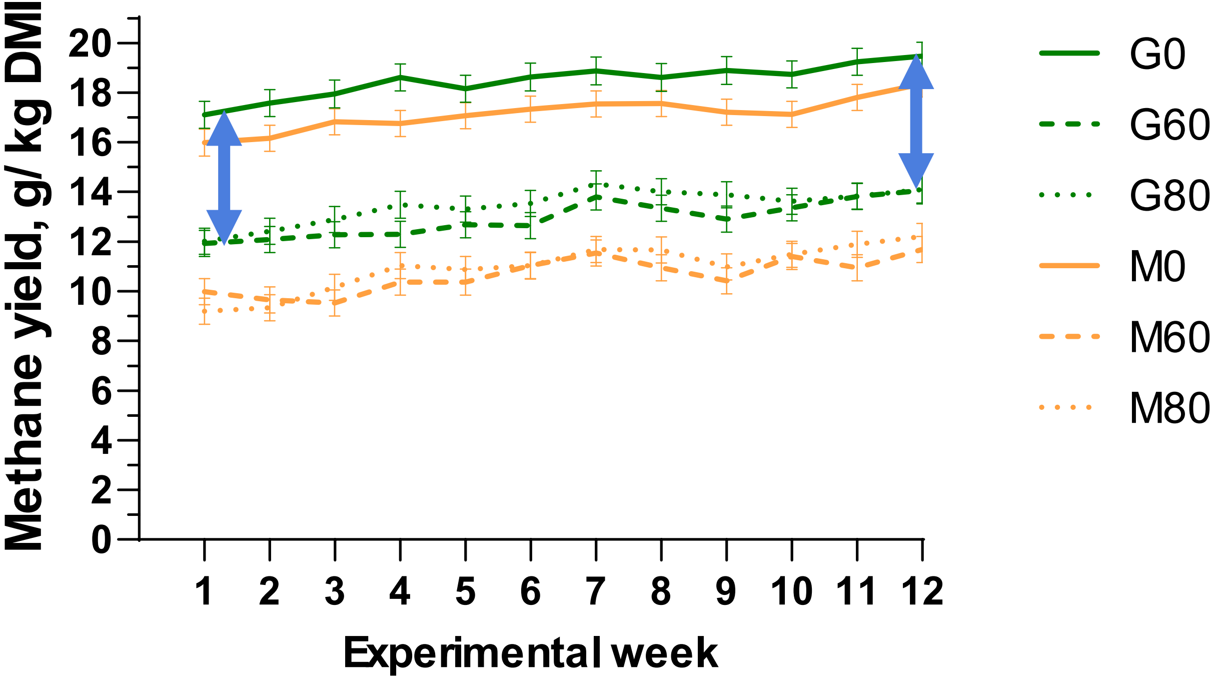
	P-value
Forage type	<0.01
3-NOP dose	<0.01*
Week	<0.01
Forage type × 3-NOP	0.27

*Greater 3-NOP-effect in multiparous cows

	P-value
Forage type	<0.01
3-NOP	<0.01*
Week	<0.01
Forage type × 3-NOP	0.28

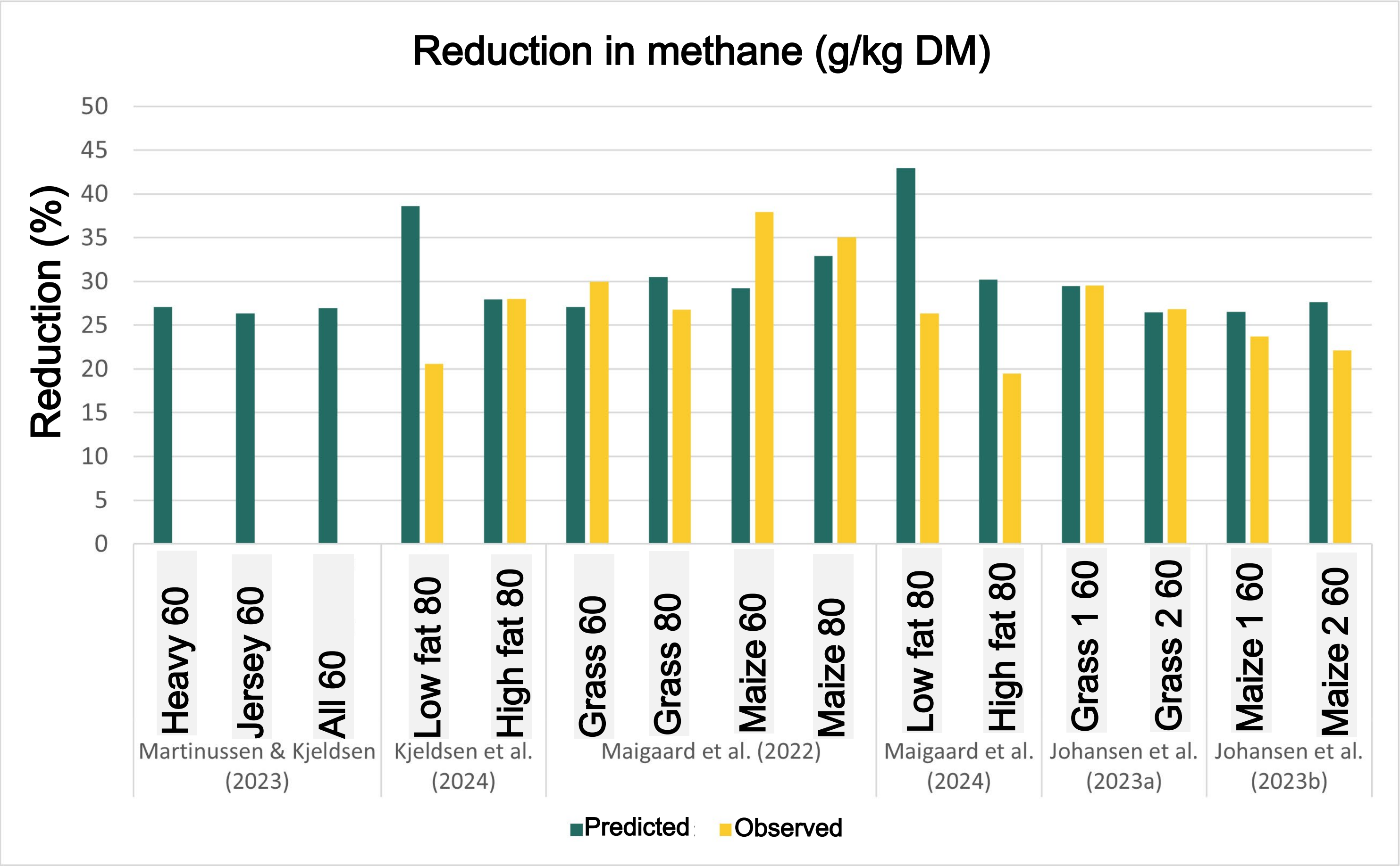
Maigaard et al. (2024)

THE EFFECT OF 3-NOP IS PERSISTENT

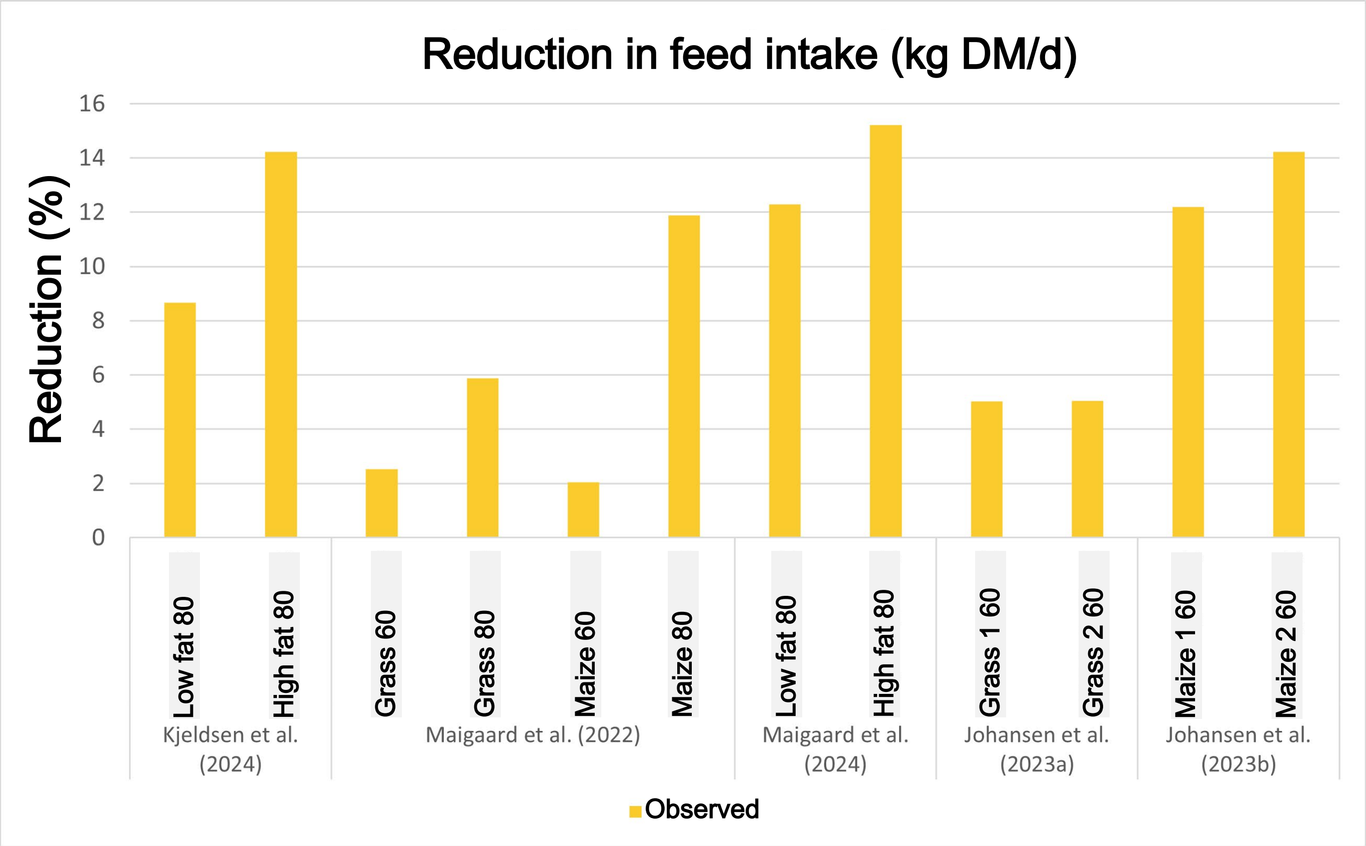


Maigaard et al. (2024)

BOVAER IN AU TRIALS – 27 % REDUCTION



BOVAER IN AU TRIALS – FEED INTAKE

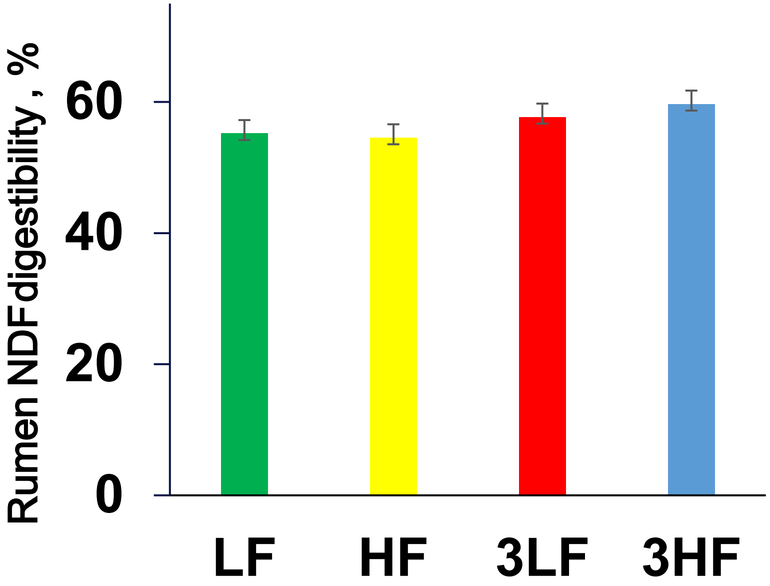


On farm trials (Arla, SEGES): No reduction in feed intake

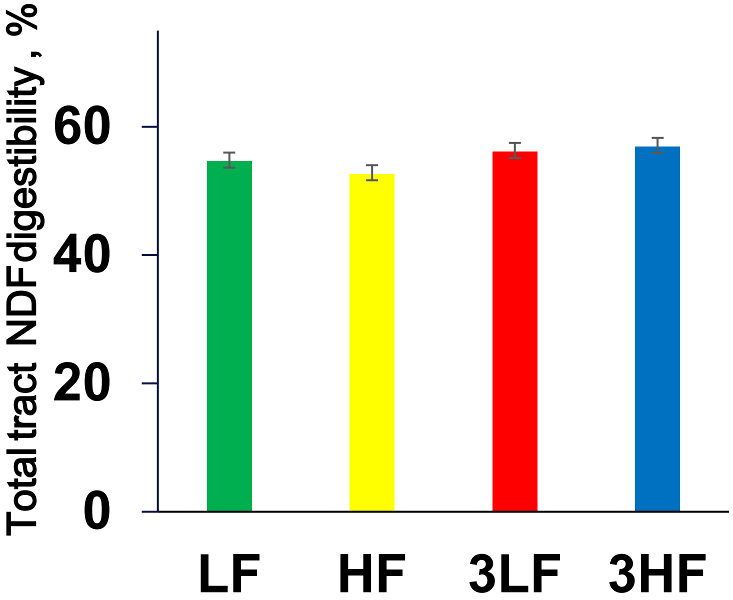
Maigaard et al. (2024)

NDF DIGESTIBILITY

?? Rumen alcohols ??



SE	P-value		
2.1	Fat	3- NOP	Fat x 3- NOP
	0.73	0.09	0.51



SE	P-value		
1.4	Fat	3- NOP	Fat x 3- NOP
	0.67	0.06	0.34

Kjeldsen et al. (2022)

TREATMENTS

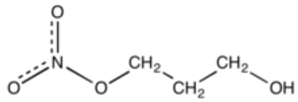
2×2×2 factorial arrangement of treatments

- Low/ high fat: 3% crude fat vs. 6% crude fat **(Fat)**
- -/+ Nitrate: 10 g/kg DM **(Nitrate)**
- -/+ 3-NOP: 80 mg/kg DM **(3-NOP)**

= 8 different diets

Fat: whole cracked rapeseed

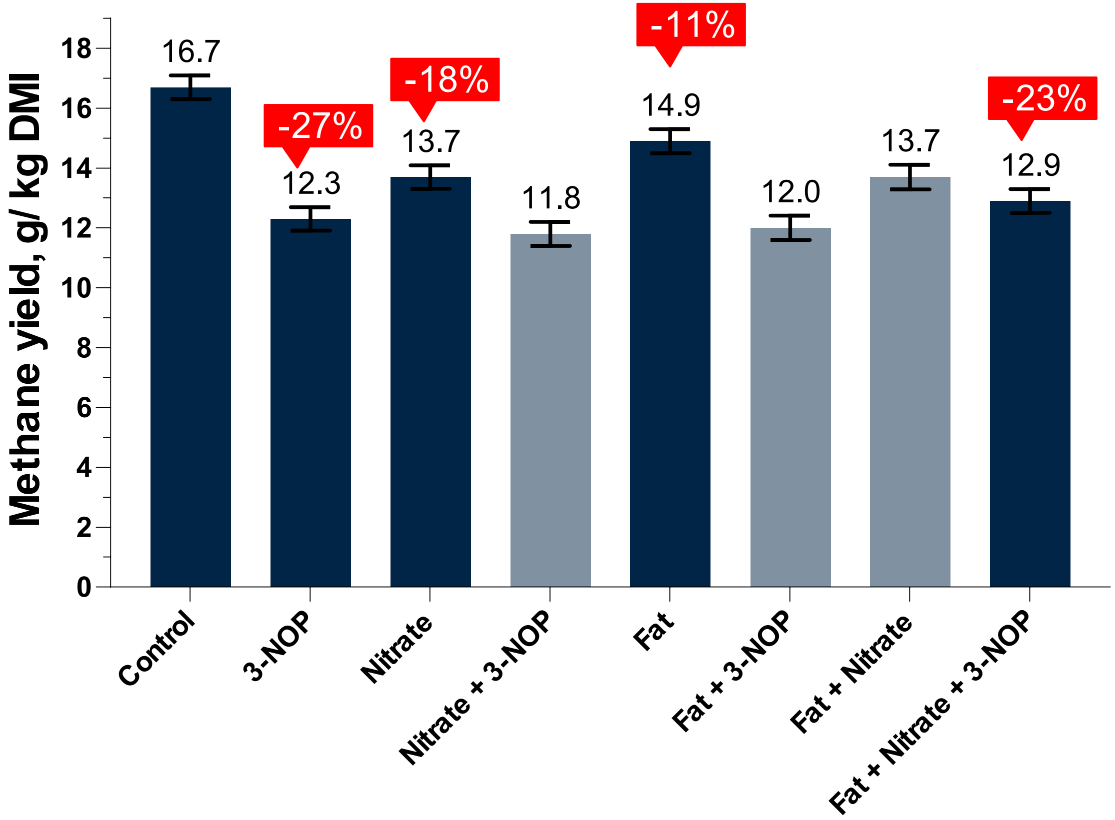
Nitrate: Calcium nitrate; SilvAir®



3-NOP: Bovaer ®

Maigaard et al. (2024)

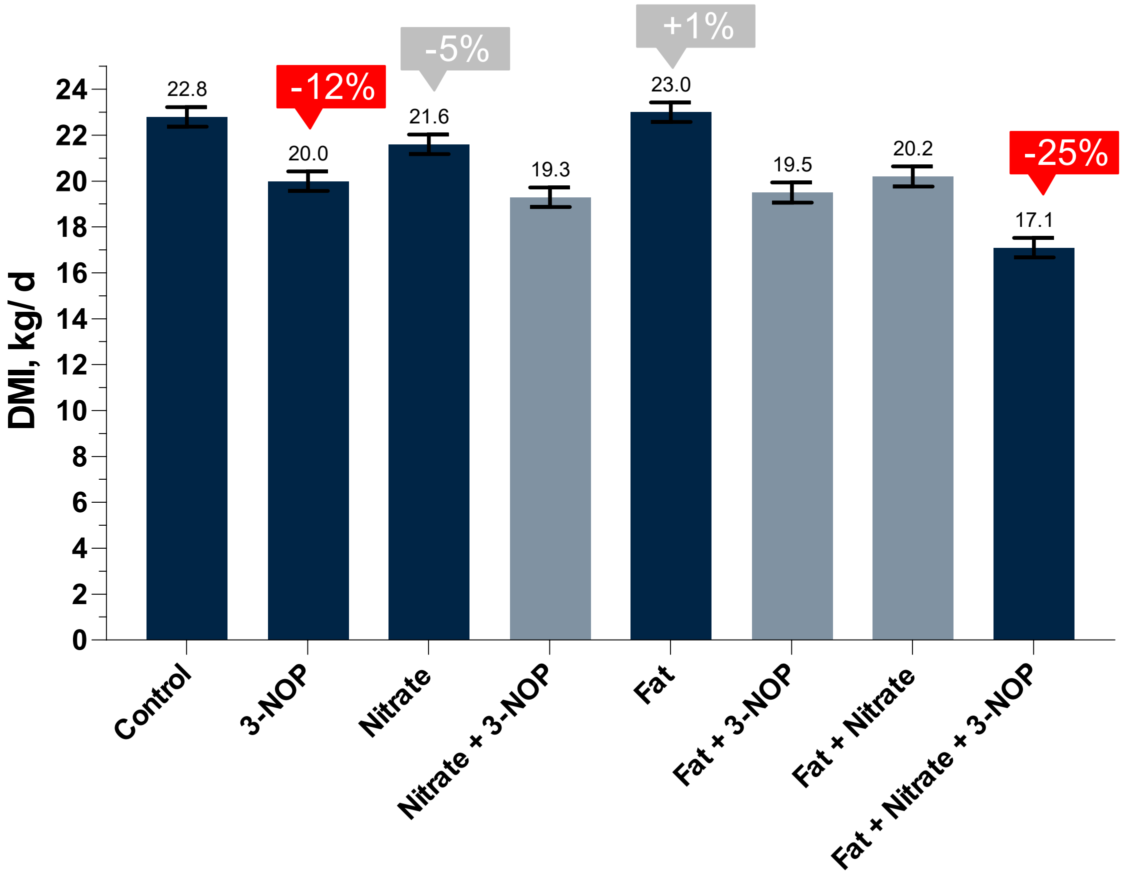
METHANEYIELD



	P-value
Fat	0.35
Nitrate	<0.01
3-NOP	<0.01
Fat x Nitrate	<0.01
Fat x 3-NOP	<0.01
Nitrate x 3-NOP	<0.01
Fat x Nitrate x 3-NOP	0.58

Maigaard et al. (2024)

DRY MATTER INTAKE

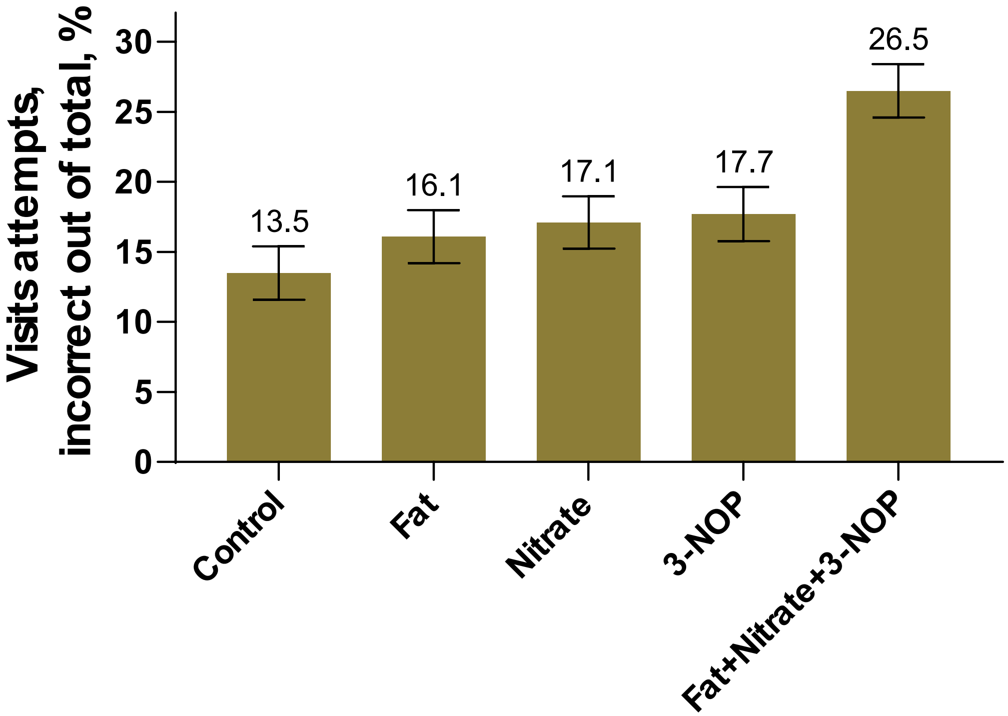


	P-value
Fat	<0.01
Nitrate	<0.01
3-NOP	<0.01
Fat x Nitrate	<0.01
Fat x 3-NOP	0.09
Nitrate x 3-NOP	0.30
Fat x Nitrate x 3-NOP	0.99

Maigaard et al. (2024)

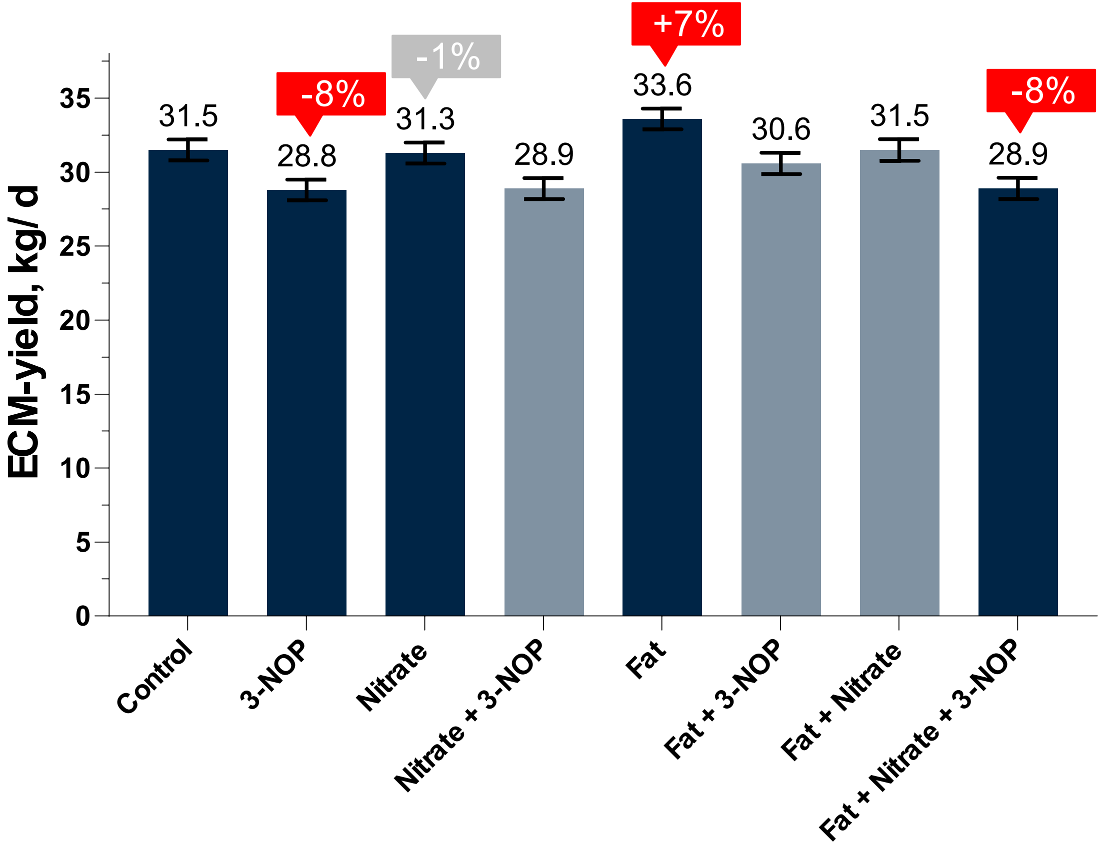
CORRECT VS. INCORRECT FEED BIN

SEARCHING FOR OTHER FEED?



	P-value
Fat	<0.01
Nitrate	0.02
3-NOP	<0.01
Fat x Nitrate	0.83
Fat x 3-NOP	0.36
Nitrate x 3-NOP	0.64
Fat x Nitrate x 3-NOP	0.40

MILKPRODUCTION

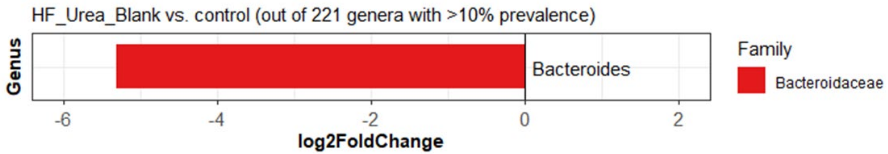


	P-value
Fat	<0.01
Nitrate	<0.01
3-NOP	<0.01
Fat x Nitrate	<0.01
Fat x 3-NOP	0.70
Nitrate x 3-NOP	0.52
Fat x Nitrate x 3-NOP	0.90

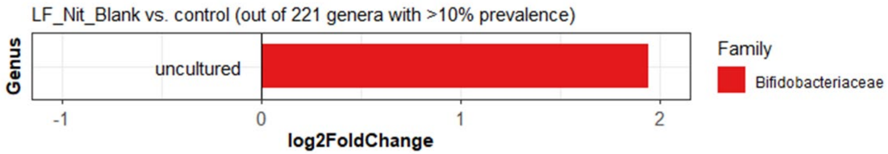
Maigaard et al. (2024)

RUMEN MICROBIOME

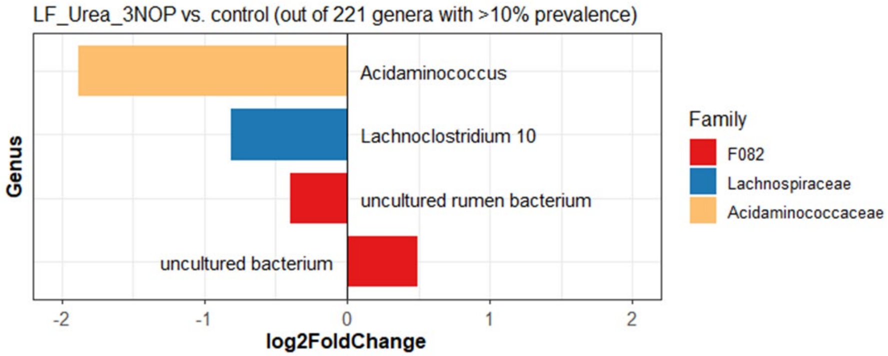
+ FAT



+ NITRATE



+ 3-NOP



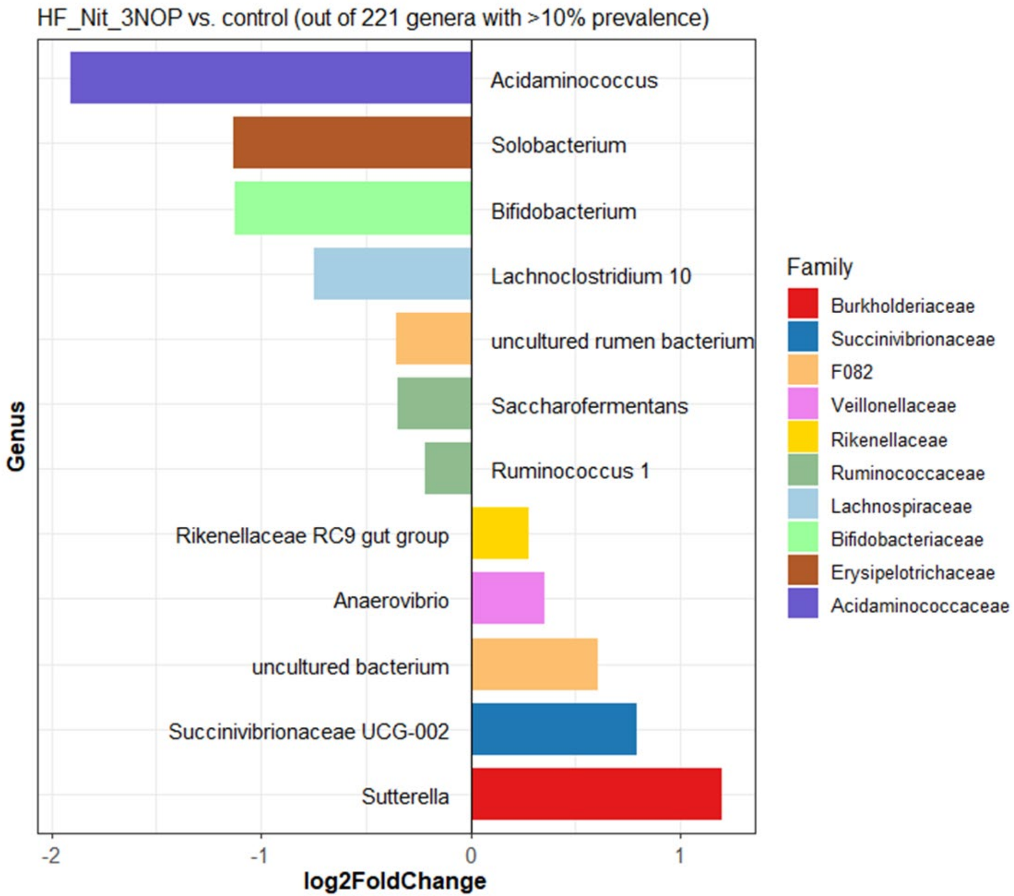
Noel et al. (2022)

RUMEN MICROBIOME

+ NITRATE

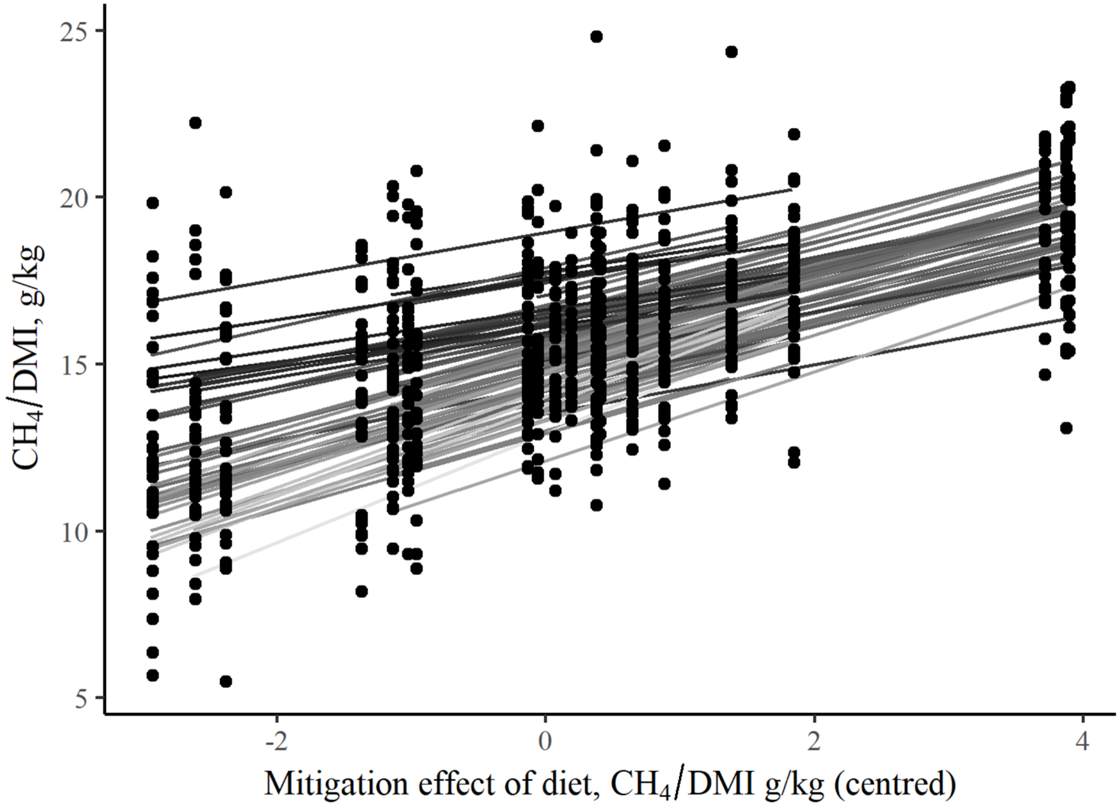
+ 3-NOP

+ FAT



Noel et al. (2022)

INDIVIDUAL COW EFFECTS – PROD. STUDY

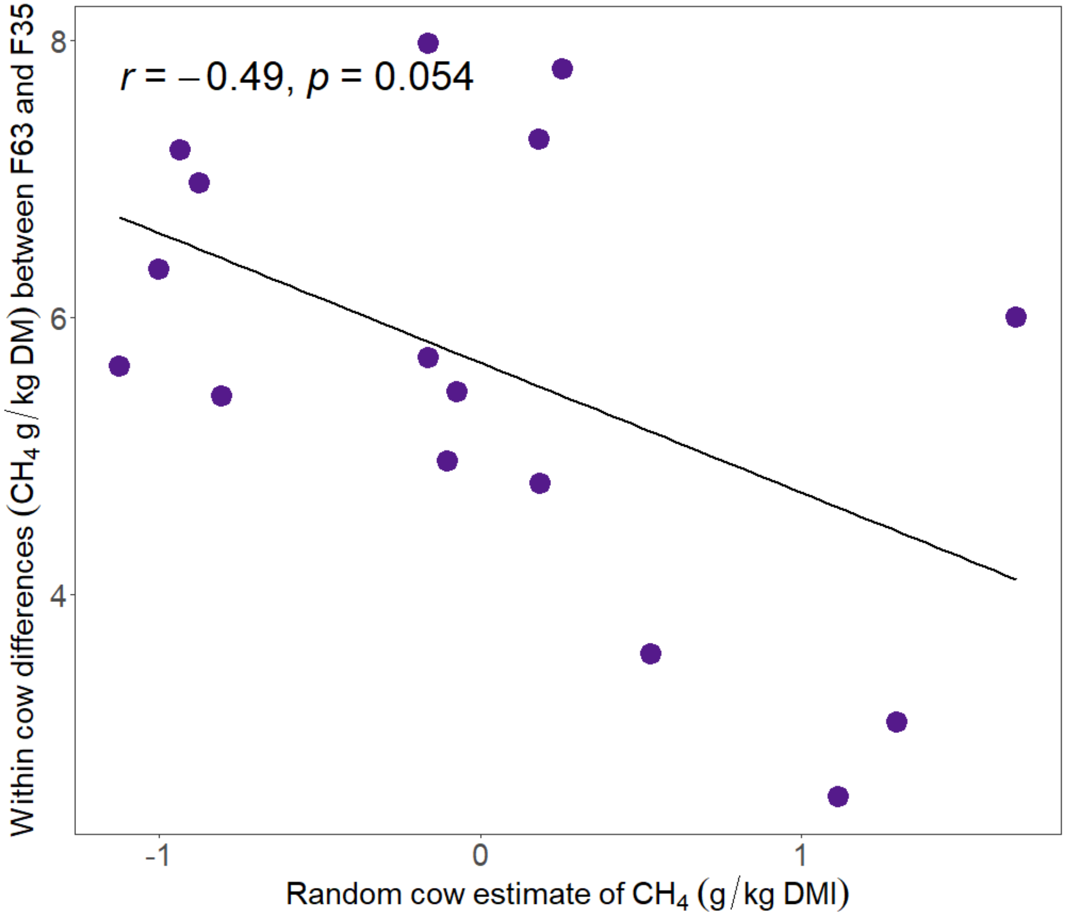


Poster 47.12 page 570
"Enteric methane and digestibility: are these phenotypes correlated in dairy cows?"
Giagnoni et al.

Poster 47.14 page 571
"How much of between-cow variation in enteric methane can performance and digestibility measures explain?"
Giagnoni et al.

Giagnoni et al. (2024)

LOW/HIGH EMITTERS – DIET INTERVENTION



Poster 34.13 page 453
"Phenotypic traits related to methane yield in dairy cows"
Kjeldsen et al.

Kjeldsen et al. (2024)

Arla

nlm vantinge
sustainable lipids

DSM

Mælkeafgiftsfonden

Cargill

Ministry of Food, Agriculture and Fisheries of Denmark



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