SMART Melken

Methane mitigation

Symposium Methane and Ammonia Mitigation in Cattle Husbandry
Tuesday December 11th, 2018, Merelbeke
Dorien Van Wesemael

Innovatiesteunpunt

AGENTSCHAP INNOVEREN & ONDERNEMEN

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Methane mitigation

- ✓ Herd management
  - High productive animals
    - relatively lower methane production per liter milk
  - Young stock management
- ✓ **<u>Manipulation of fermentation in the rumen</u>**
  - Feed additives
  - Diet formulation

SMART Melken

"Nutritional strategies towards an economic and environmental sustainable dairy farm: focus on methane and nitrogen efficiency"

Producing milk with the least possible environmental impact, but still at a competitive cost.

Stikstof en Methaan Aanpakken voor een Rundvee Toekomst

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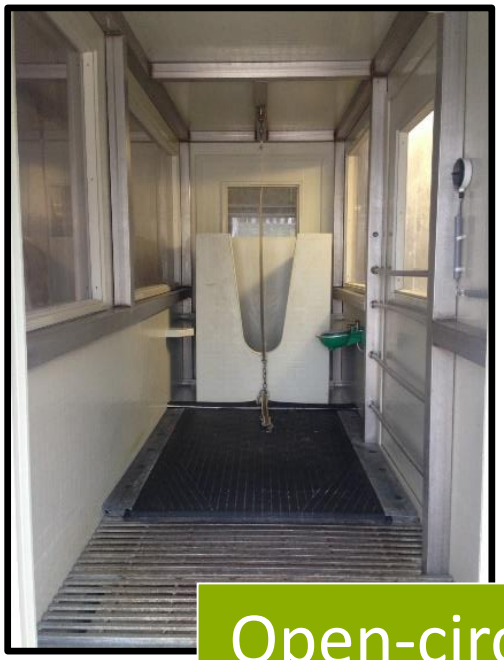
"Nutritional strategies towards an economic and environmental sustainable dairy farm: focus on methane and nitrogen efficiency"

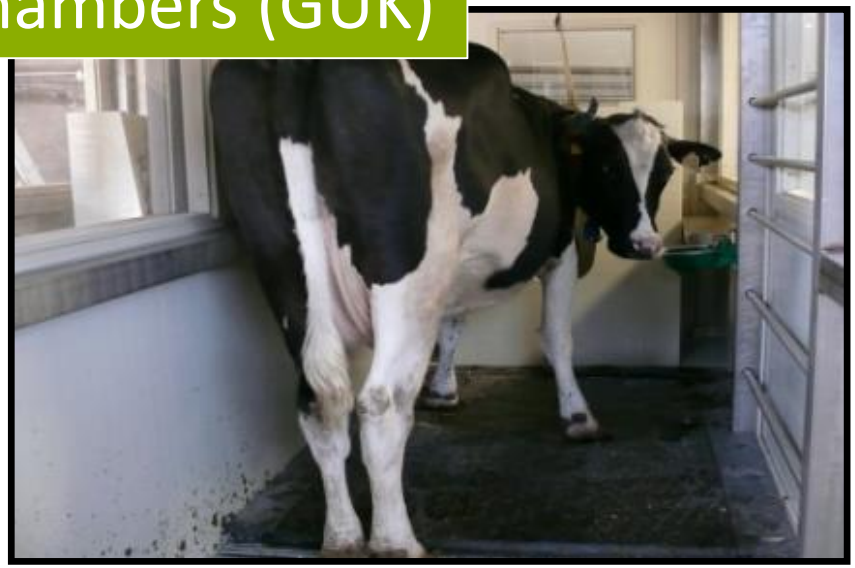
- *In vivo* trials (2 phases)
- Life cycle analysis (carbon footprint) -> next presentation
- Economic analysis

➢ Online tool and fact sheets -> demo

Phase 1 – Screening



Open-circuit chambers (GUK)

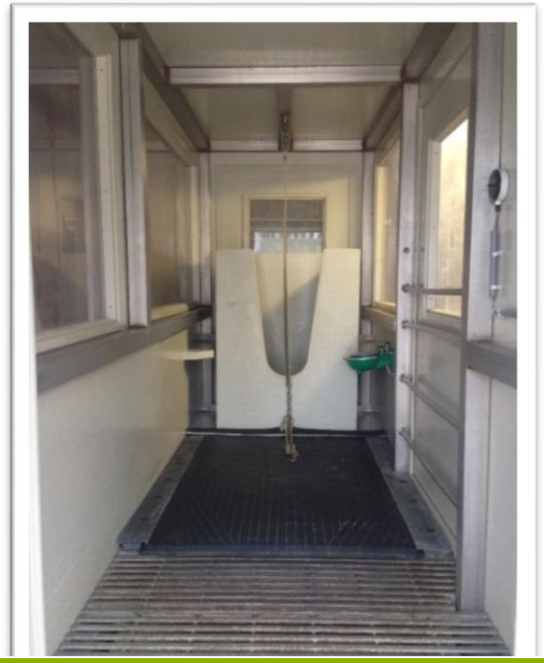


Experimental set-up Screening

	W1 - W3	W4 - W8	W9	W10 - W14	W15
Reference group	Adap.	REF	GUK	REF	GUK
Treated group	Adap.	REF	GUK	TRTM	GUK

Duration: 15 weeks

- 3 weeks adaptation
- 6 weeks reference (REF)
  => Open-circuit chambers (GUK)
- 6 weeks treatment (TRTM)
  => Open-circuit chambers (GUK)



Open-circuit chambers (GUK)

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Important remark

- ✓ First screening of additives, components and diet compositions
- ✓ Not designed as milk production trial
  - Too low number of animals
  - The results of milk production and composition are only an indication
- ✓ Trials with more cows are needed
  - Production trials in real practice dairy stables

Phase 2 – Practice

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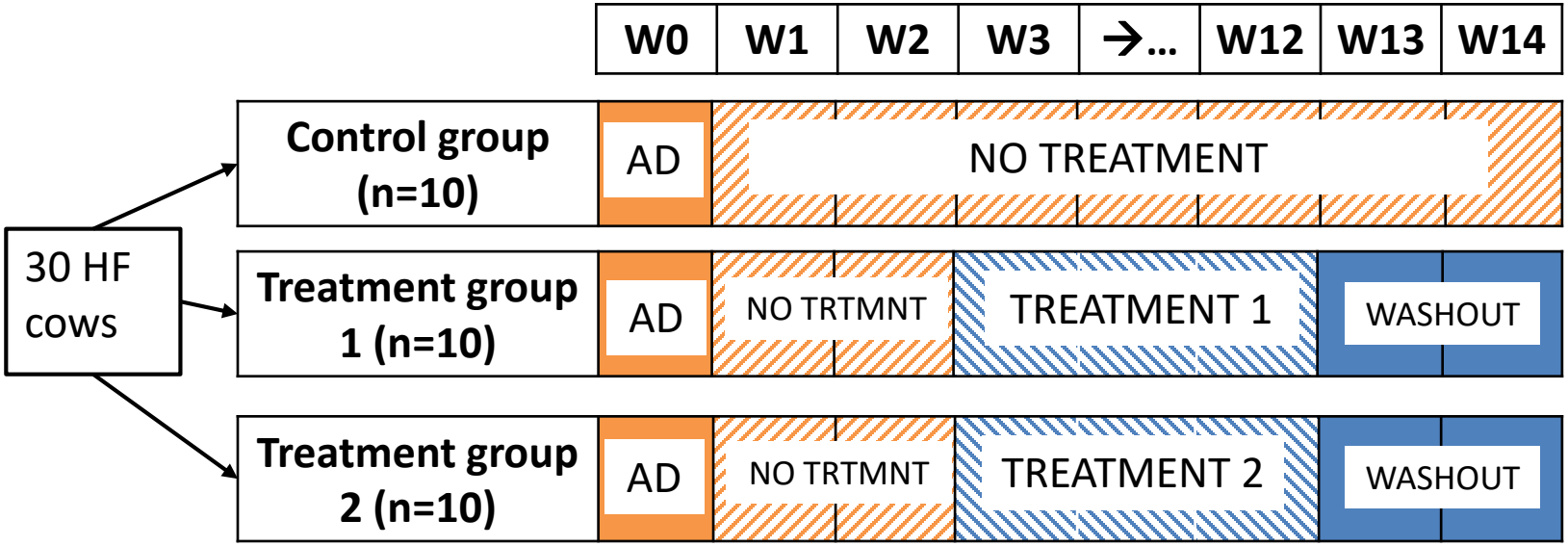
GreenFeed

Hooibeekhoeve

LV Den Hamer

Experimental set-up Practice



GreenFeed

Screening trials (part 1)

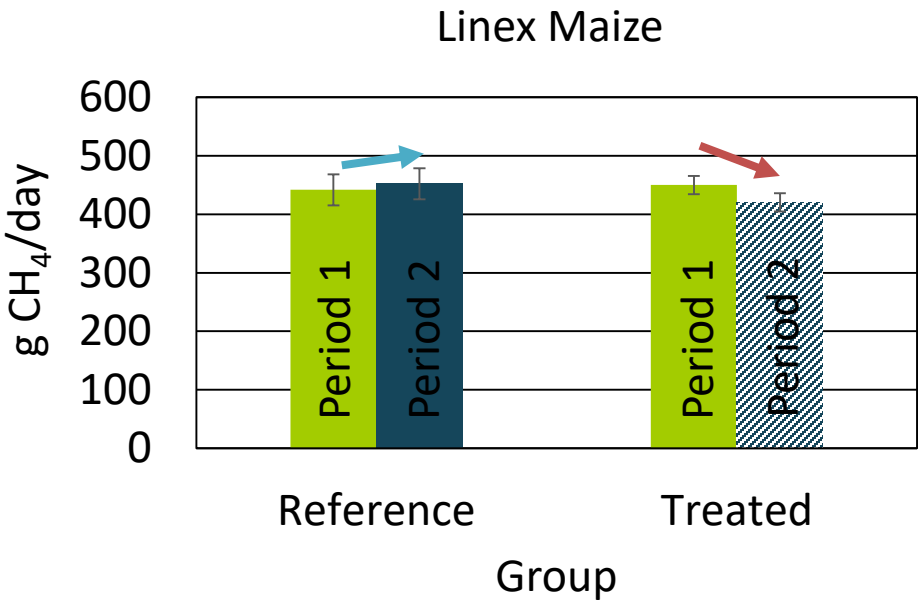
- **Linex (Arvesta) with ration rich in grass silage**
- **Linex (Arvesta) with ration rich in maize silage**
- **Additive DSM: 3-nitrooxypropanol**

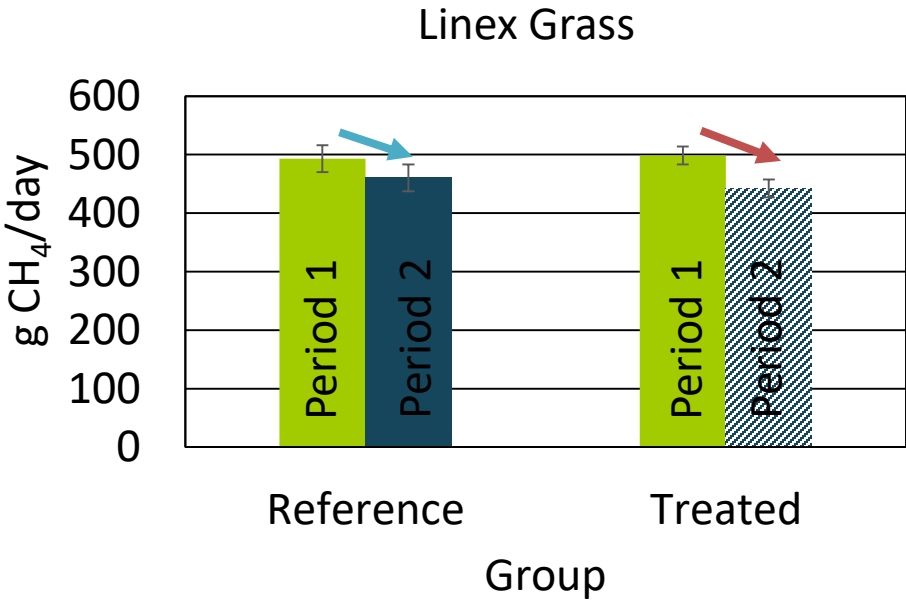
Screening Linex

- ✓ Treatment = balanced concentrate with **linseed and linseed oil**
- ✓ ! Replacing balanced concentrate in reference diet based on **energy (VEM) values** only (iso-energetic diets)

% in total diet (DM) (% in roughage mixture (DM))	**Linex grass**	**Linex maize**
Maize silage	18 (25)	45 (63)
Grass silage	45 (63)	18 (25)
Pressed beet pulp	8 (11)	8 (11)
Concentrate	29	26
	3,5 kg Linex	**3,3 kg Linex**

Results





Group	Reference cows		Treated cows		p value group*period
Period	1	2	1	2	
Linex Maize g CH_4/day	442	452	450	420	0,04
Linex Grass g CH_4/day	493	460	499	442	0,50

Results

EXPERIMENT	PARAMETER	SCREENING (GUK)	PRACTICE (GreenFeed)
LINEX GRASS	FPCM production - kg/day		
	CH_4 production - g CH_4/day		
	CH_4 intensity - g CH_4/kg FPCM		
LINEX MAIZE	FPCM production - kg/day		
	CH_4 production - g CH_4/day		
	CH_4 intensity - g CH_4/kg FPCM		

Practice Linex

LV Den Hamer: Linex with ration rich in maize silage

% in roughage mixture (DM)	LV Den Hamer	Linex maize
Maize silage	62	63
Grass silage	32	25
Beet pulp or Chicory pulp	6	11

Results

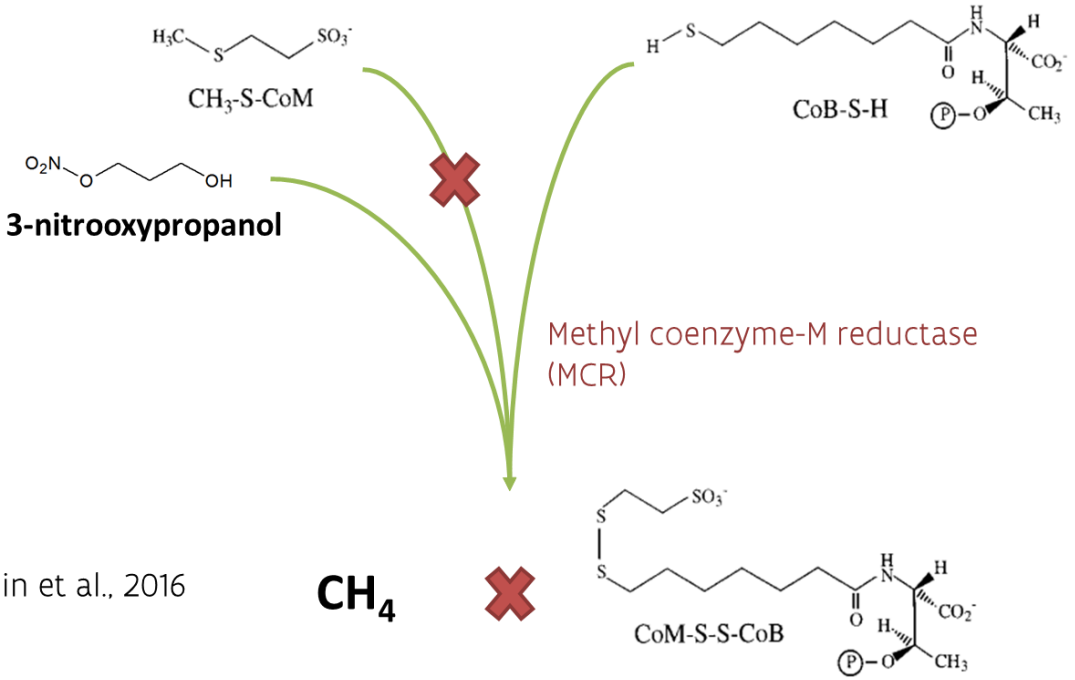
EXPERIMENT	PARAMETER	SCREENING (GUK)	PRACTICE (GreenFeed)
LINEX GRASS	FPCM production - kg/day	No effect	
	CH_4 production - g CH_4/day	No effect	
	CH_4 intensity - g CH_4/kg FPCM	No effect	
LINEX MAIZE	FPCM production - kg/day	No effect	
	CH_4 production - g CH_4/day	-9%	
	CH_4 intensity - g CH_4/kg FPCM	-11%	

LINEX LOWERS METHANE EMISSIONS WHEN COMBINED WITH A RATION RICH IN MAIZE SILAGE. COMBINED WITH A RATION RICH IN GRASS SILAGE LINEX DOES NOT LOWER METHANE EMISSIONS.

Screening 3-NOP

- ✓ Treatment = **synthetic additive**
  - ✓ Low amounts needed

17 g of 3-NOP per cow per day



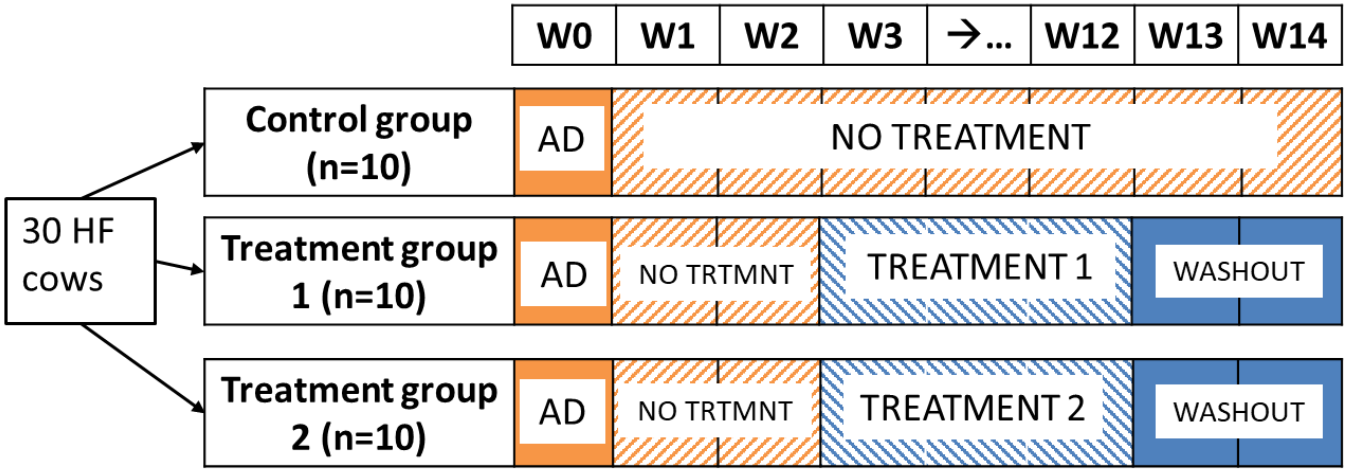
Duin et al., 2016

Results

Group	Reference cows		Treated cows		p value group*period
Period	1	2	1	2	
DMI kg/d	21,2	20,7	21,1	20,0	0,40
FPCM kg/d	33,0	30,1	31,6	28,6	0,96
CH_4 g/d	433 ↗	442	441 ↘	369	< 0,001
CH_4/kg FPCM	13,6 ↗	14,8	14,3 ↘	13,0	< 0,001

EXPERIMENT	PARAMETER	SCREENING (GUK)	PRACTICE (GreenFeed)
3-NITROOXYPROPANOL (3-NOP, DSM)	FPCM production - kg/day	?	
	CH_4 production - g CH_4/day	?	
	CH_4 intensity - g CH_4/kg FPCM	?	

Practice 3-NOP



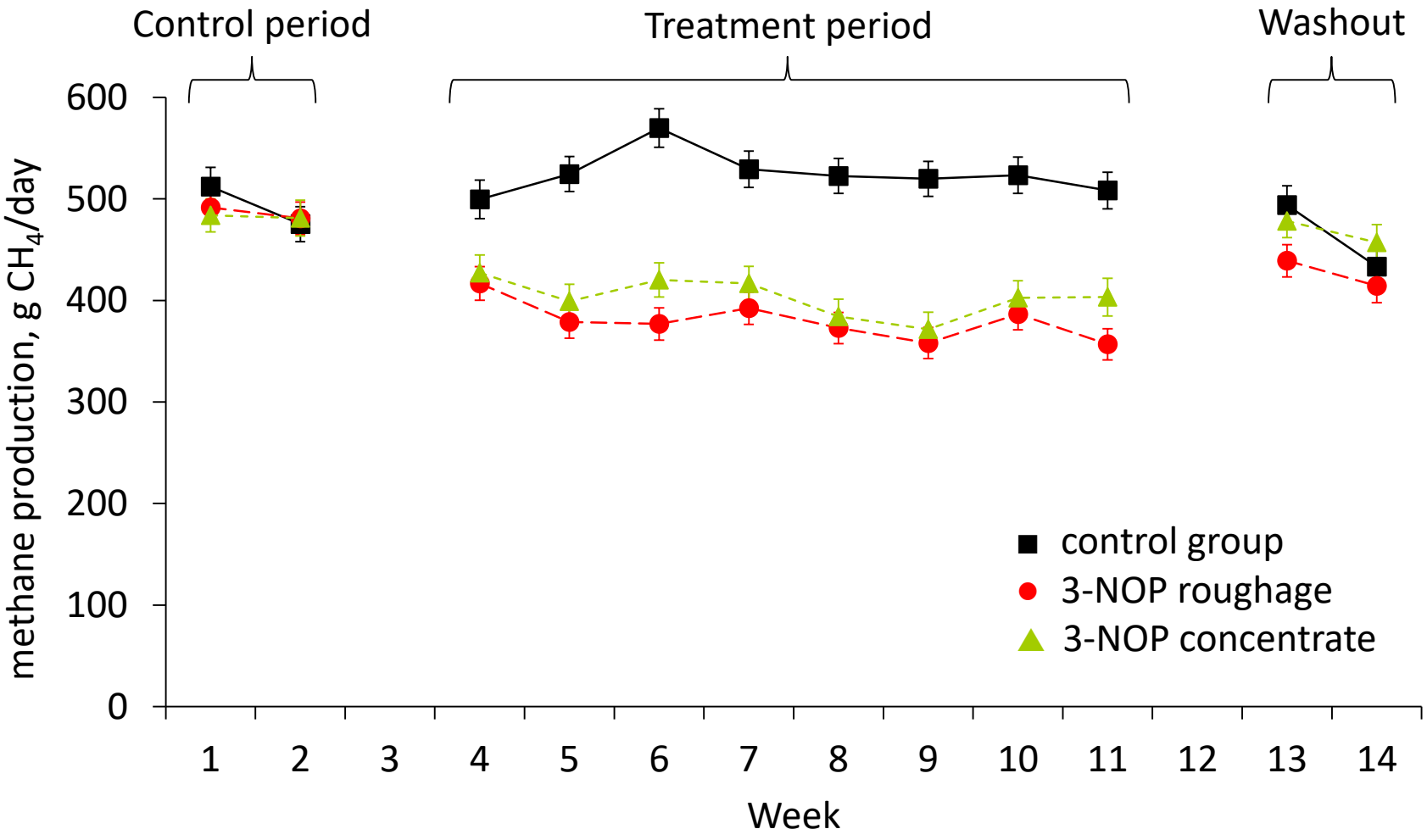
Three groups: **control**

+ 3-NOP in roughage mixture

+ 3-NOP in concentrate pellet

16 g of 3-NOP per cow per day

Results


Control period
Treatment period
Washout
methane production, g CH_4/day
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Week
control group
3-NOP roughage
3-NOP concentrate

Results

	Treatment period		
Group	Control	3-NOP rough.	3-NOP conc.
DMI kg/d	22,5	21,3	22,3
FPCM (kg/day)	29,1	27,6	29,4
CH_4 g/d	525[a]	380[b] ↘	403[b] ↘
CH_4/kg FPCM	18,5[a]	14,2[b] ↘	14,1[b] ↘

Van Wesemael et al. (in press)

Results

EXPERIMENT	PARAMETER	SCREENING (GUK)	PRACTICE (GreenFeed)
3-NITROOXYPROPANOL (3-NOP, DSM)	FPCM production - kg/day	No effect	?
	CH_4 production - g CH_4/day	-18%	?
	CH_4 intensity - g CH_4/kg FPCM	-18%	?

FEED SUPPLEMENTATION WITH 3-NOP IS CLEARLY A PROMISING STRATEGY FOR LOWERING ENTERIC METHANE EMISSIONS. THE ADDITIVE IS NOT YET COMMERCIALLY AVAILABLE.

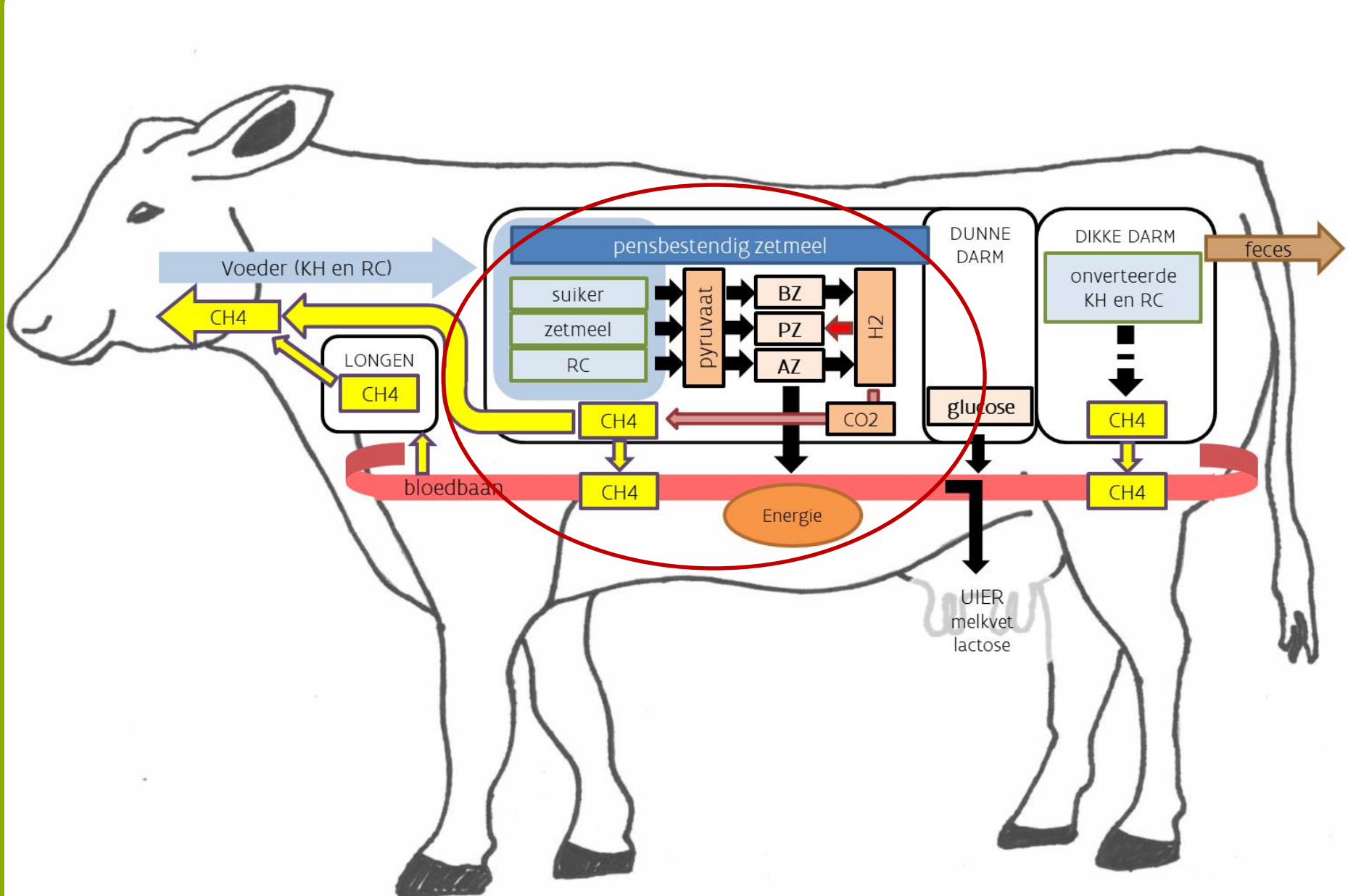
Screening trials (part 2)

Diet composition - use of by-products:

- **Ration rich in maize silage**
- **Brewers' grains and rapeseed meal**
  - replacing soybean meal

Maize (Scr)

Screening maize silage



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Results

Maize (Scr)

Group	Reference cows		Treated cows		p value group*period
Period	1	2	1	2	
DMI kg/d	20,6	21,8	20,3	21,4	0,44
FPCM kg/d	29,4	29,1	27,8	27,2	0,82
CH_4 g/d	435	437	423	439	0,53
CH_4/kg FPCM	15,1	15,2	15,3	16,3	0,26

EXPERIMENT	PARAMETER	SCREENING (GUK)	PRACTICE (GreenFeed)
MAIZE SILAGE	FPCM production - kg/day	No effect	
	CH_4 production - g CH_4/day	No effect	
	CH_4 intensity - g CH_4/kg FPCM	No effect	

A BALANCED DIET RICH IN MAIZE SILAGE DOES NOT LOWER ENTERIC METHANE EMISSIONS COMPARED TO A BALANCED DIET RICH IN GRASS SILAGE.

Screening Brewers' grains and Rapeseed meal (BG+RSM)

- ✓ Treatment = brewers' grains and rapeseed meal
- ✓ ! Replacing **soybean meal** to lower carbon footprint of the diet -> see next presentation

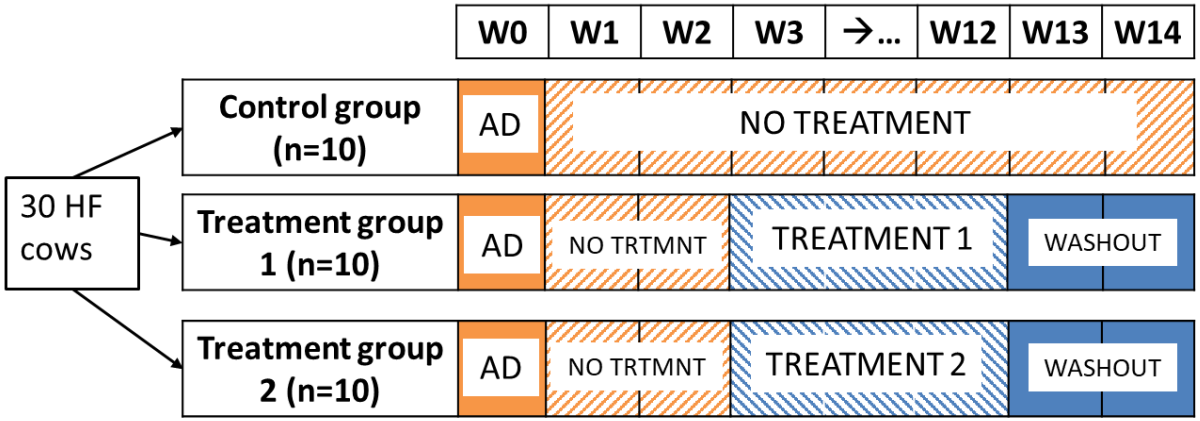
BG + RSM (Scr)

Results

Group	Reference cows		Treated cows		p value group*period
Period	1	2	1	2	
DMI kg/d	22,3	21,7	22,5	22,1	0,53
FPCM kg/d	32,0 ↘	28,8	31,6 ↗	32,5	< 0,001
CH_4 g/d	452 ↘	445	509 ↘	422	< 0,001
CH_4/kg FPCM	14,7 ↗	16,2	16,3 ↘	13,1	< 0,001

EXPERIMENT	PARAMETER	SCREENING (GUK)	PRACTICE (GreenFeed)
BREWERS' GRAINS + RAPESEED MEAL	FPCM production - kg/day		
	CH_4 production - g CH_4/day		
	CH_4 intensity - g CH_4/kg FPCM		

Practice Brewers' grains and Rapeseed meal

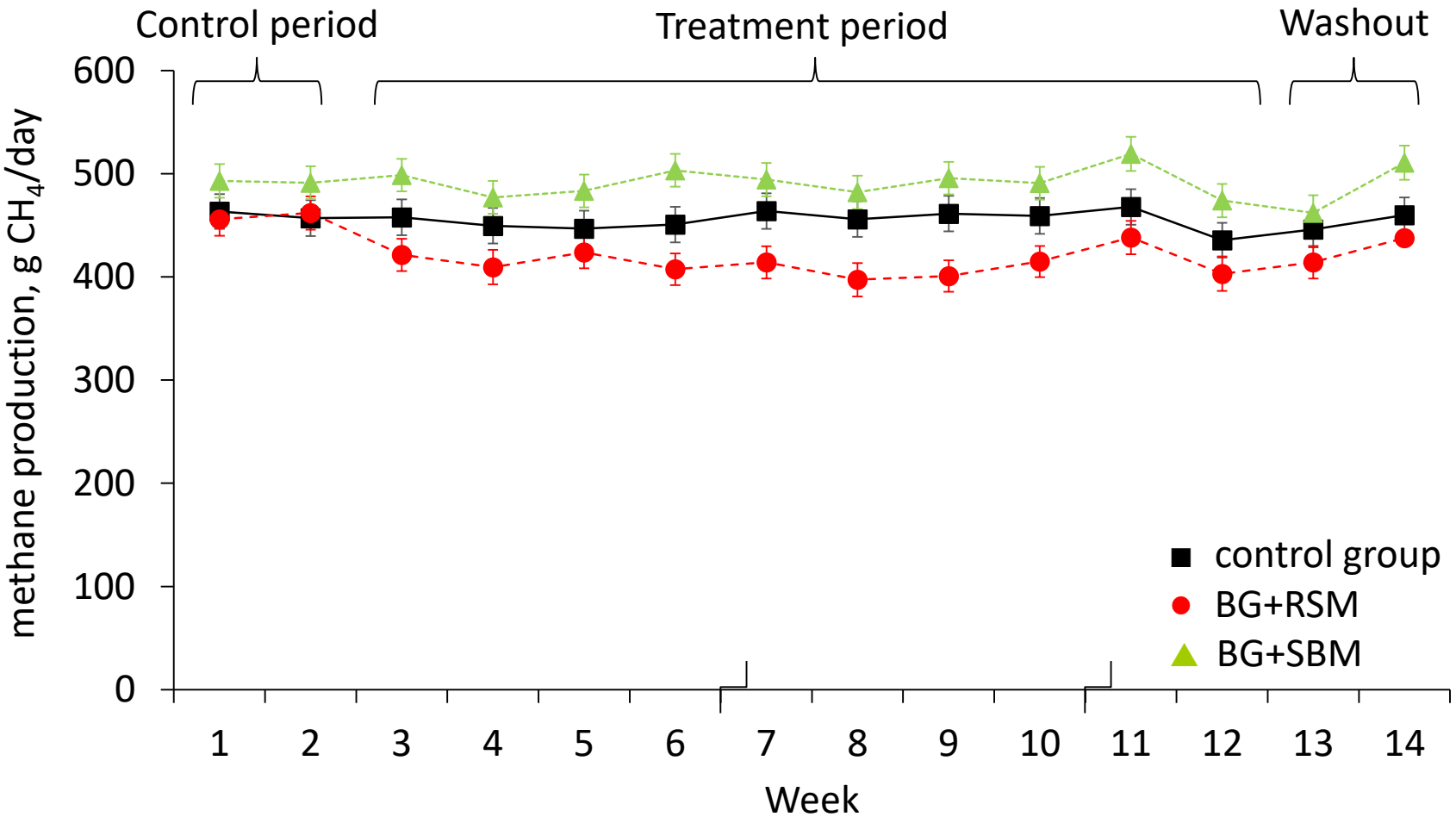


Three groups: **control**

+ brewers' grains and rapeseed meal (BG+RSM)

+ brewers' grains and soybean meal (BG+SBM)

Results


Control period
Treatment period
Washout
methane production, g CH_4/day
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Week
control group
BG+RSM
BG+SBM

Results

	Treatment period		
Group	Control	BG+RSM	BG+SBM
DMI kg/d	23,3	25,6	24,9
FPCM kg/d	34,3	35,9	36,2
CH_4 g/d	455^{ab}	413^{b}	492^{a}
CH_4/kg FPCM	$13,3^{a}$	$11,5^{b}$	$13,7^{a}$

BG + RSM

Results

EXPERIMENT	PARAMETER	SCREENING (GUK)	PRACTICE (GreenFeed)
BREWERS' GRAINS + RAPESEED MEAL	FPCM production - kg/day	+13%	?
	CH_4 production - g CH_4/day	-16%	?
	CH_4 intensity - g CH_4/kg FPCM	-30%	?
BREWERS' GRAINS + SOYBEAN MEAL	FPCM production - kg/day		
	CH_4 production - g CH_4/day		
	CH_4 intensity - g CH_4/kg FPCM		

COMBINING BREWERS' GRAINS AND RAPESEED MEAL HAS POTENTIAL TO LOWER METHANE EMISSIONS. COMBINING BREWERS' GRAINS AND SOYBEAN MEAL LACKS THIS POTENTIAL.

Conclusions

LINEX LOWERS METHANE EMISSIONS WHEN COMBINED WITH A RATION RICH IN MAIZE SILAGE. COMBINED WITH A RATION RICH IN GRASS SILAGE LINEX DOES NOT LOWER METHANE EMISSIONS.

A BALANCED DIET RICH IN MAIZE SILAGE DOES NOT LOWER ENTERIC METHANE EMISSIONS COMPARED TO A BALANCED DIET RICH IN GRASS SILAGE.

FEED SUPPLEMENTATION WITH 3-NOP IS CLEARLY A PROMISING STRATEGY FOR LOWERING ENTERIC METHANE EMISSIONS.
THE ADDITIVE IS NOT YET COMMERCIALLY AVAILABLE.

Conclusions

Combining brewers' grains and rapeseed meal has potential to lower methane emissions. Combining brewers' grains and soybean meal lacks this potential.

Manure emissions are not taken into account, small shifts of emissions are still possible.
Nitrogen and Phosphorus excretion: to be calculated.

Methane mitigation with nutritional strategies is possible, but a broader approach is desirable.

Thanks to:

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Vlaanderen is ondernemen

Co-funders SMART Melken

BOERENBOND trouw aan land- en tuinbouw

AVEVE

DELACON Phytogenic Feed Additives

DSM BRIGHT SCIENCE. BRIGHTER LIVING.

AVEVE Aveve Biochem

Provincie Antwerpen HOOIBEEKHOEVE

colruyt

Qlip quality assurance in agrofood

Campina

DANONE

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UNIVERSITEIT GENT

Partners

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ILVO

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