

Methane in cattle husbandry: mitigation by feed(additives)



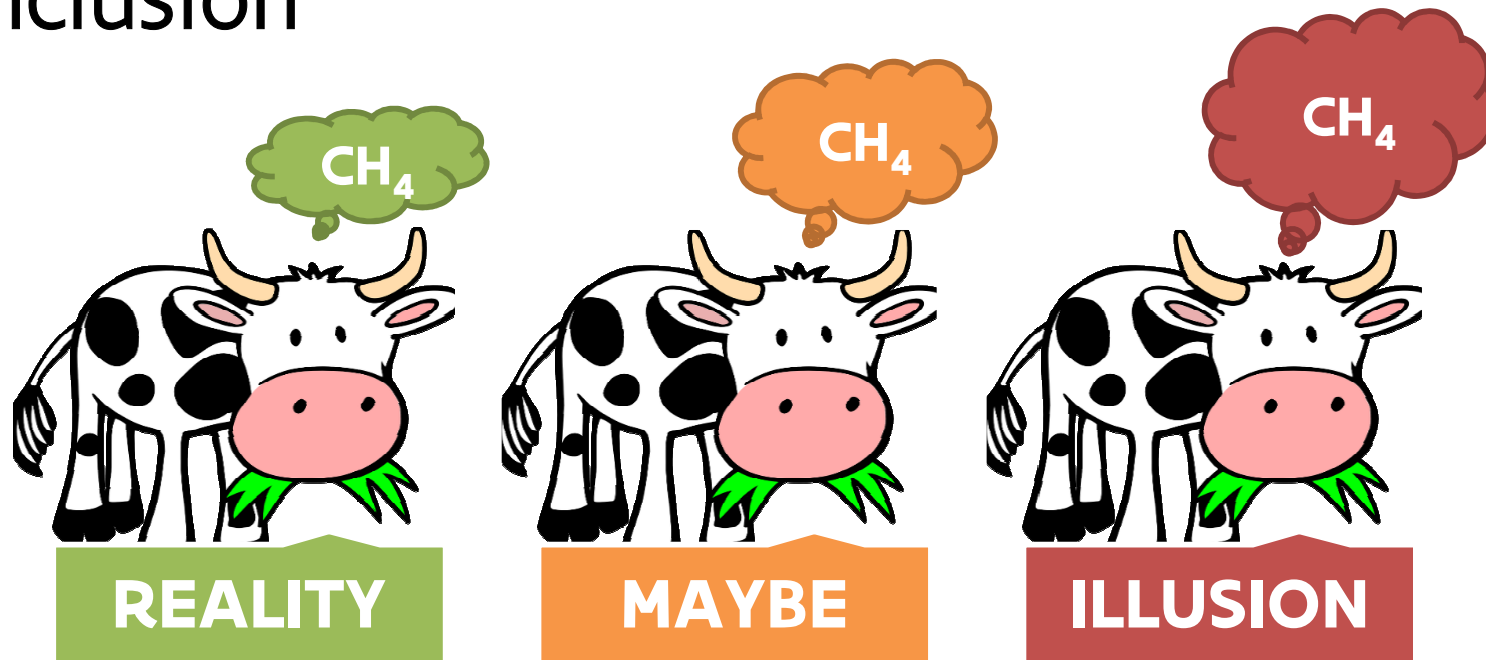
In vivo methane mitigation in the long term through addition of methane mitigating components in Flemish dairy cattle rations

Symposium VLAIO LA traject *SMART MELKEN*
Thursday October 6th, 2016, Melle
Dorien Van Wesemael

Overview

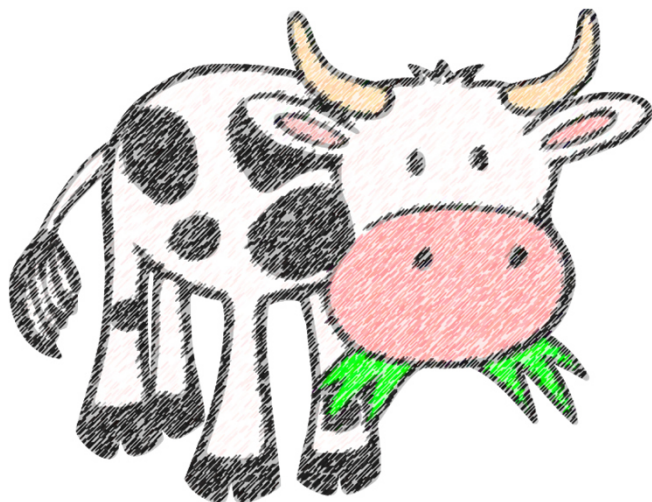


- ✓ Introduction
- ✓ Material & Methods
- ✓ Results
- ✓ Conclusion

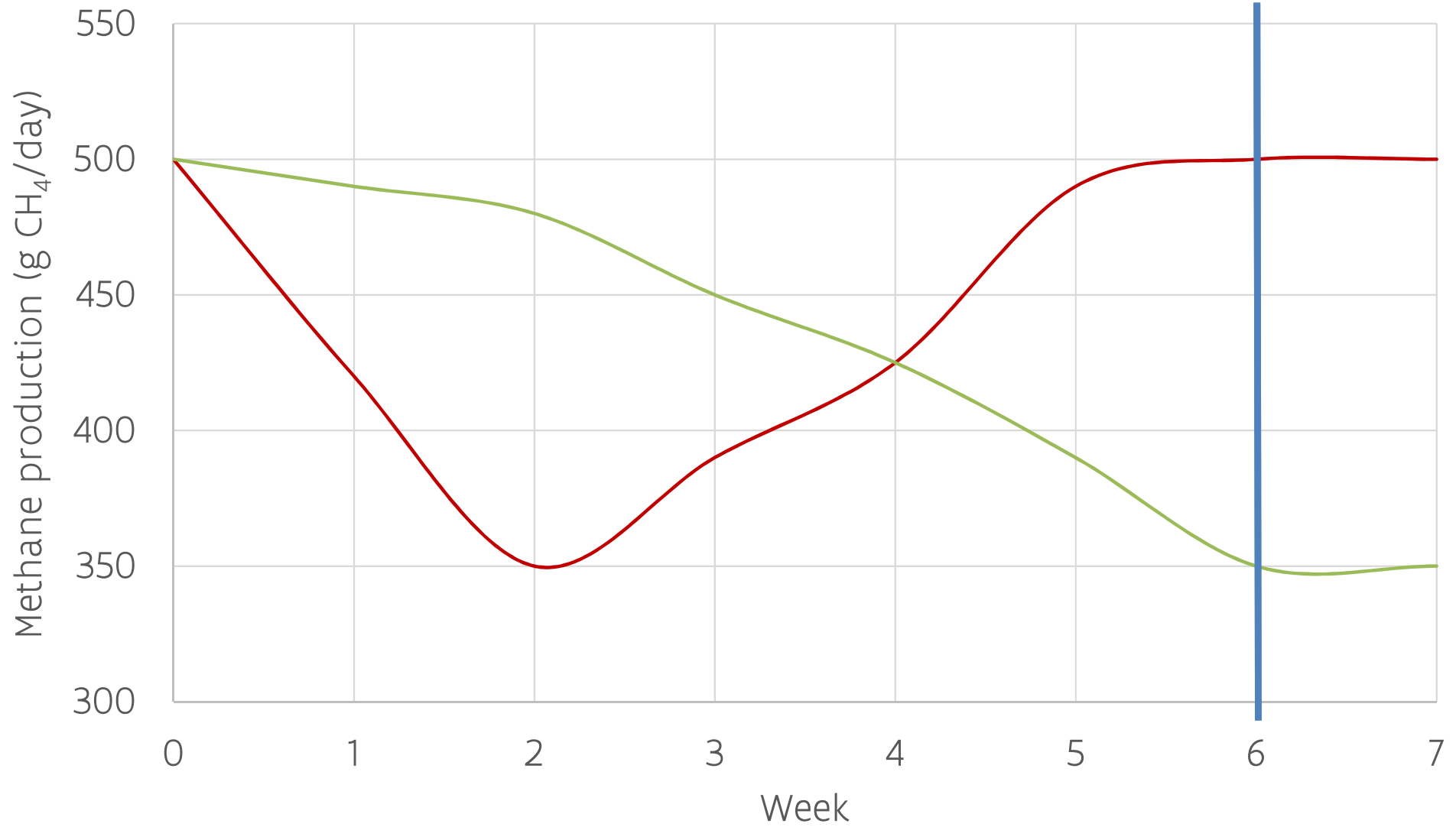


Introduction

In vivo methane mitigation in the
long term through addition of
methane mitigating components
in Flemish dairy cattle rations.

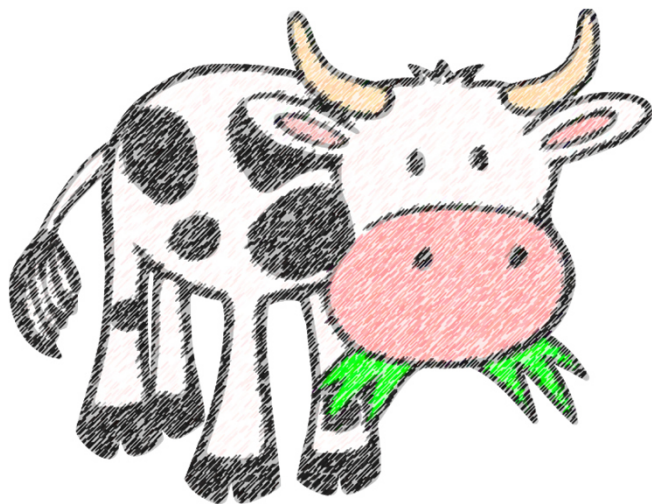


In the long term



Introduction

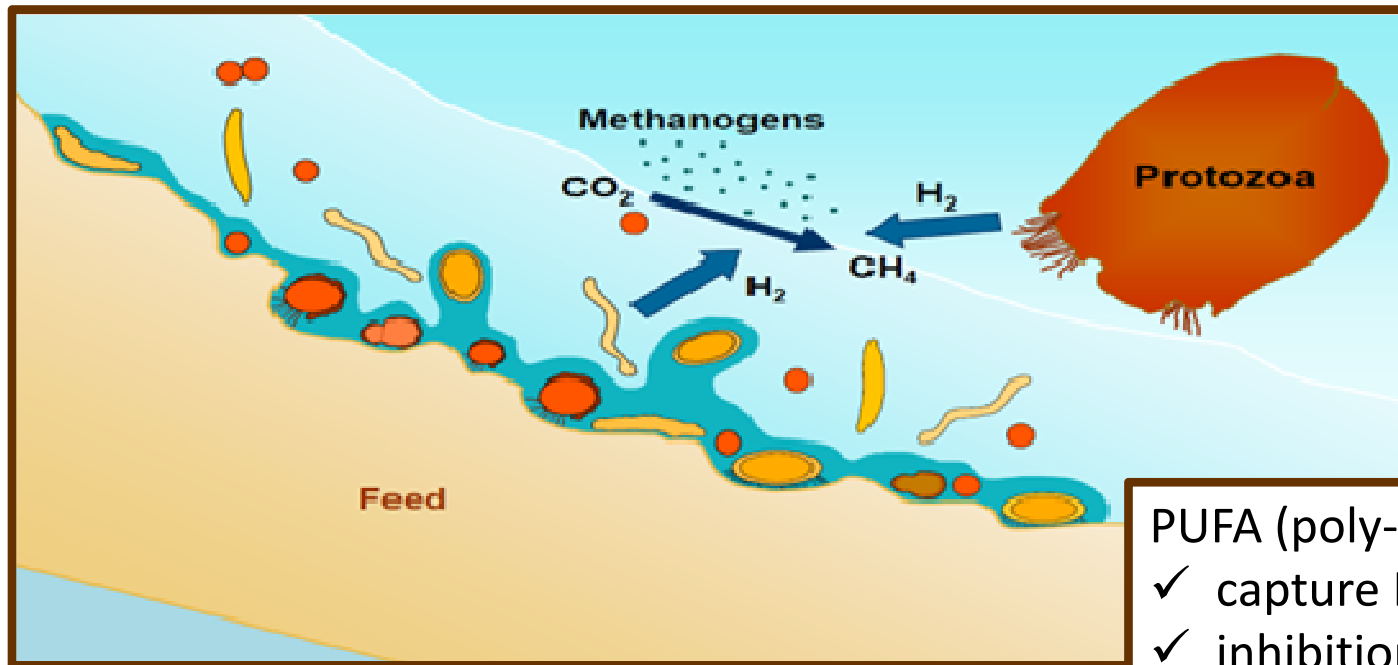
In vivo methane mitigation in the
long term through addition of
methane mitigating components
in Flemish dairy cattle rations.



Methane mitigation

- ✓ Herd management
 - Genetic selection
 - low methane production
 - high feed efficiency
 - High productive animals
 - relatively lower methane production per liter milk
- ✓ Manipulation of fermentation in the rumen
 - Feed additives

Manipulation of fermentation in the rumen



PUFA (poly-unsaturated fatty acids):
✓ capture H_2
✓ inhibition of microbial growth

Production of methane: microbial process to eliminate hydrogen (H_2) in the rumen

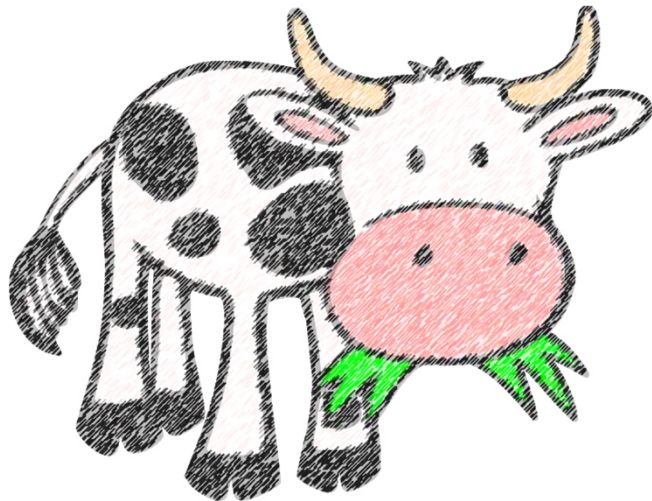
1. Less H_2 production

2. Elimination of H_2 in other ways

3. Elimination of methanogens (methane producing micro-organisms)

Introduction

In vivo methane mitigation in the
long term through addition of
methane mitigating components
in Flemish dairy cattle rations.



① **com-po-nent**

1 a constituent element

② **ad-di-tive**

1 a substance added in small amounts to something else to improve, strengthen or otherwise alter it

Flemish dairy cattle rations

Basal diets of the trials

% in roughage mixture (DM)	Trial 1	Trial 2	Trial 3	Trial 4
Maize silage	25	65	50	45
Grass silage	65	25	40	45
Pressed beet pulp	10	10	10	10

% in total diet (DM)	Trial 1	Trial 2	Trial 3	Trial 4
Roughage	71	73	68	76
Concentrate	29	27	32	24

Material & Methods

	W1 - W3	W4 - W8	W9	W10 - W14	W15
Ctr group (n=2)	Adap.	CTRL	GUK	CTRL	GUK
Trt group (n=8)	Adap.	CTRL	GUK	TRTM	GUK

Duration: 15 weeks

- > 3 weeks adaptation
- > 6 weeks control (CTRL)
 - => Open-circuit chambers
- > 6 weeks treatment (TRTM)
 - => Open-circuit chambers



Open-circuit chambers (GUK)

Material & Methods

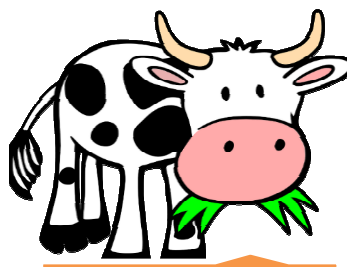
Animals: 10 high-productive cows (>30 kg milk/day)

- > 2 control cows
- > 8 treated cows (2 x 4)

BUT only 6 GUK's are available!

- GUK measurements spread over two weeks
- measure control group both weeks

	W1 - W3	W4 - W8	W9	W10	W11 - W14	W15	W16
Ctr group (2)	Adap.	CTRL	G 1	G 2	CTRL	G 1	G 2
Trt group 1 (4)	Adap.	CTRL	G 1	TRTM	TRTM	G 1	
Trt group 2 (4)	W2 - W4	W5 - W9	W10	W11 - W14	W15	W16	
	Adap.	CTRL	G 2	TRTM	TRTM	G 2	



MAYBE

Important remark

- ✓ First screening of additives and components
- ✓ 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 or zootechnic trials in dairy stables

Results

✓ Four trials

1. AVEVE Linex (linseed)
with ration rich in grass silage
2. AVEVE Linex (linseed)
with ration rich in maize silage
3. DSM 3-nitrooxypropanol (3-NOP)
4. AVEVE Biochem Hopextract

AVEVE Linex

Com·po·nent = a constituent element



3,3 - 3,5 kg Linex












- ✓ Treatment = balanced concentrate with linseed and linseed oil
 - ✓ Linseed is rich in α -linolenic acid (ALA – C18:3) => PUFA!
- ✓ ! Replacing balanced concentrate in control diet based on energy (VEM) values only (iso-energetic diets)
 - ✓ Nutritional implications

AVEVE Linex

(g/kg DM)	DM	CP	CFat	CF	STRCH	SU	VEM (/kg DM)	DVEo	OEBo	FOSo
Linex (10/500)	905	242	138	88	130	101	1168	109	80	463
F14-37 (Trial 1)	885	191	34	57	364	110	1149	125	22	575
F10-14 (Trial 2)	890	178	34	88	224	110	1118	120	5	654

Group		Control		Treatment		Difference	p value
Period		CTRL	TRTM	CTRL	TRTM		
Crude Fat (kg/day)	Trial 1	0,59	0,59	0,63	0,93	+0,30	< 0,001
	Trial 2	0,66	0,59	0,70	0,93	+0,23	< 0,001
Starch (kg/day)	Trial 1	3,31	3,30	3,55	2,56	-0,99	< 0,001
	Trial 2	5,21	4,58	5,29	4,35	-0,94	< 0,001

Results AVEVE Linex grass

Group	Control cows		Treated cows		p value group*period
	CTRL	TRTM	CTRL	TRTM	
DMI kg/d	20,2	21,1 	21,4	21,6 = 	< 0,001
Milk kg/d	25,5	24,4 	27,6	27,9 =	<u>0,19</u>
FPCM kg/d	27,9	26,4	30,3	29,4	0,50
Milk fat g/d	1168	1105	1284	1238	0,76
Milk protein g/d	966	900	1022	948	0,77
CH ₄ g/d	493	460 	499	442 	0,50
CH ₄ /kg DMI	24,4	21,8 	23,4	20,4 	0,81
CH ₄ /kg milk	19,5	19,2 = 	18,5	16,1 	<u>0,12</u>
CH ₄ /kg FPCM	18,0	17,8	16,6	15,1	0,32
CH ₄ /CO ₂	0,039	0,036 	0,038	0,034 	0,66

=> No production trial!

Results AVEVE Linex maize

Group	Control cows		Treated cows		p value group*period
	CTRL	TRTM	CTRL	TRTM	
DMI kg/d	22,4	20,8 ↓	23,5	21,7 ↓	0,58
Milk kg/d	27,6	28,1 =	29,3	29,0 =	0,60
FPCM kg/d	30,2	29,7	31,6	31,7	0,75
Milk fat g/d	1293	1268	1343	1378	0,50
Milk protein g/d	977	923	1032	982	0,96
CH ₄ g/d	442	452 ↑	450	420 ↓	< 0,05
CH ₄ /kg DMI	19,7	21,7 ↑	19,2	19,4 =	< 0,05
CH ₄ /kg milk	16,7	16,8	15,7	15,2	0,52
CH ₄ /kg FPCM	15,0	15,8 ↑	14,5	13,7 ↓	<u>0,08</u>
CH ₄ /CO ₂	0,036	0,037 ↑	0,034	0,033 ↓	<u>0,09</u>

DSM 3-NOP

Ad·di·tive = a substance added in small amounts to something else to improve, strengthen, or otherwise alter it.



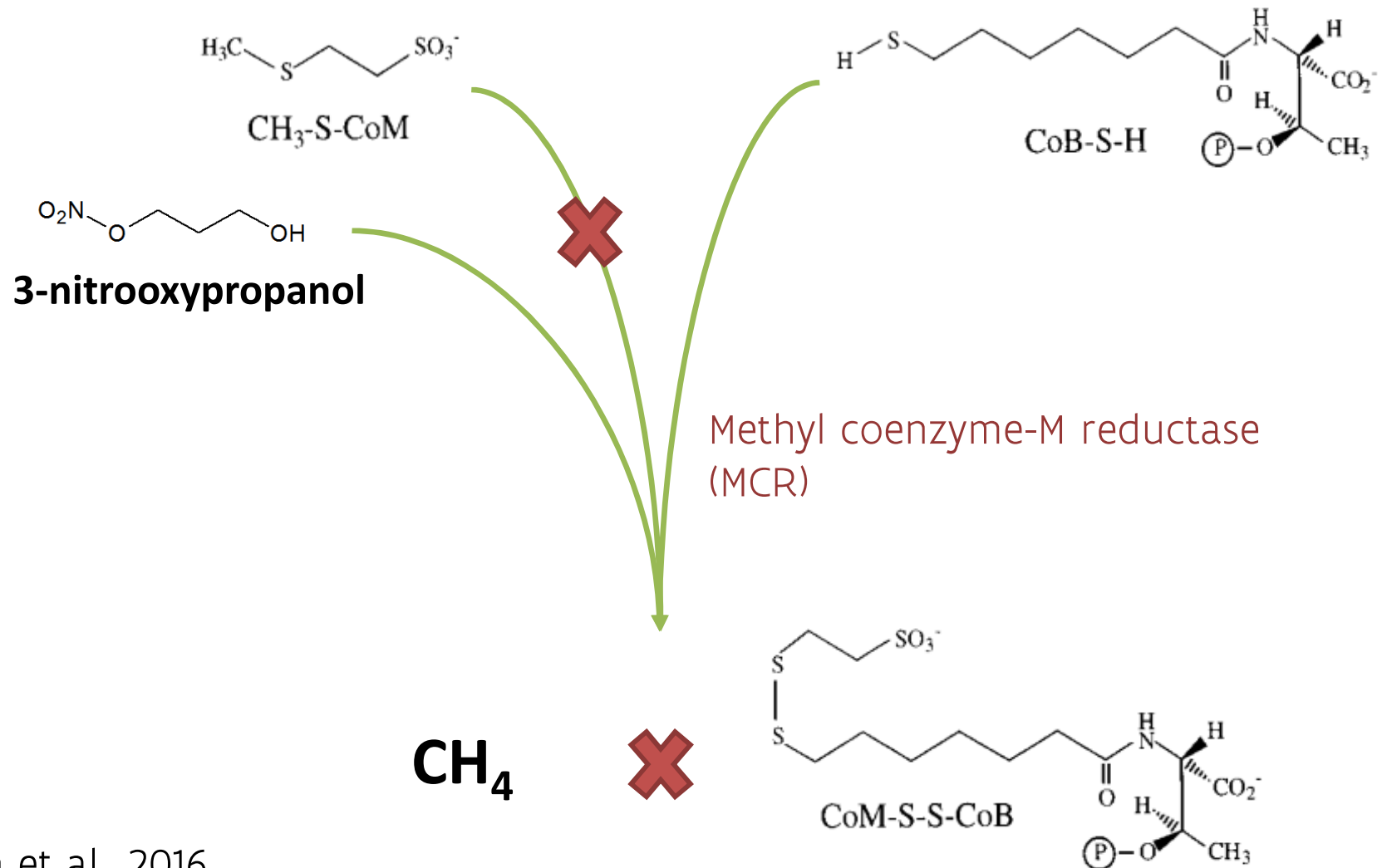
17 g/dag

- ✓ Treatment = **synthetic additive**
 - ✓ Mixed with soybean meal and oil
- ✓ ! Control cows received placebo additive
 - ✓ Mixed with soybean meal and oil
- ✓ This additive is under development

Methane mitigation by 3-NOP

Mode of action 3-NOP:

inhibition of the MCR enzyme → no CH₄ is formed



Duin et al., 2016

Results DSM 3-NOP

Group	Control cows		Treated cows		p value group*period
	CTRL	TRTM	CTRL	TRTM	
DMI kg/d	21,2	20,8 ↓	21,1	20,0 ↓	0,37
Milk kg/d	32,5	30,9 ↓	30,0	27,4 ↓	0,58
FPCM kg/d	33,0	30,2	31,6	28,6	0,91
Milk fat g/d	1377	1149	1371	1172	0,86
Milk protein g/d	973	861	924	897,4	0,88
CH ₄ g/d	433	442 ↑	441	369 ↓	< 0,001
CH ₄ /kg DMI	20.5	21.3 ↑	20.9	18.5 ↓	< 0,001
CH ₄ /kg milk	13.8	14.5 ↑	14.9	13.6 ↓	< 0,01
CH ₄ /kg FPCM	13.7	14.8	14.3	13.1	< 0,01
CH ₄ /CO ₂	0.035	0.036 ↑	0.036	0,030 ↓	< 0,001

AVEVE Biochem Hopextract

- ✓ Treatment = **plantextract** | (hop) Ad·di·tive = a substance added in small amounts ...
- ✓ ! Very low dose: incorporated in pelleted concentrate

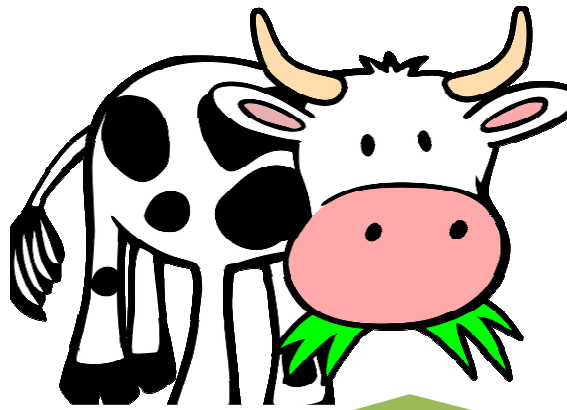
0,4 g/dag



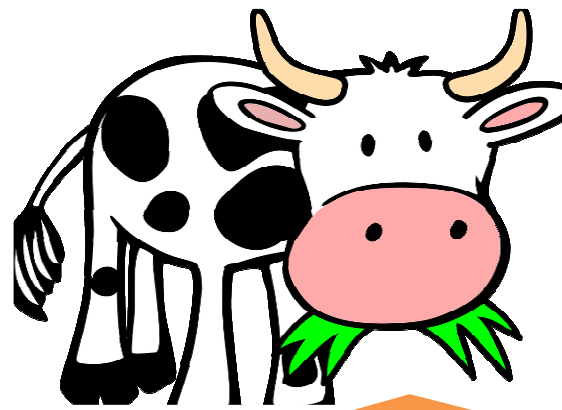
Results AVEVE Biochem

Group	Control cows		Treated cows		p value group*period
	CTRL	TRTM	CTRL	TRTM	
DMI kg/d	19,9	19,2 ↓	20,4	19,9 ↓	0,27
Milk kg/d	29,2	26,4 ↓	26,4 =	26,4 =	< 0,05
FPCM kg/d	30,0	27,0 ↓	28,1	28,8 ↑	< 0,01
Milk fat g/d	1238	1085	1210	1223	<u>0,06</u>
Milk protein g/d	965	926	861	944	< 0,05
CH ₄ g/d	404	408 =	442	430 ↓	0,20
CH ₄ /kg DMI	20,3	21,3 ↑	21,6	21,6 =	<u>0,07</u>
CH ₄ /kg milk	14,1	15,4 ↑	17,4	16,6 ↓	< 0,01
CH ₄ /kg FPCM	13,4	15,0	16,5	15,2	< 0,01
CH ₄ /CO ₂	0,035	0,036	0,035	0,036	0,58

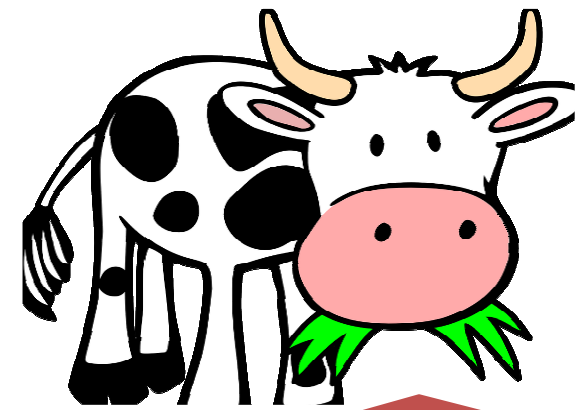
=> No production trial!



REALITY



MAYBE



ILLUSION

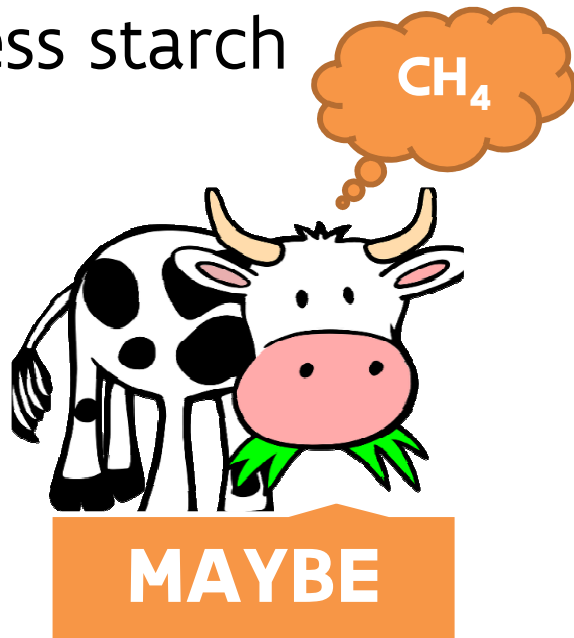
Methane mitigation with feeding strategies: reality or illusion?

FIRST CONCLUSIONS *IN VIVO* TRIALS

Reality or illusion?

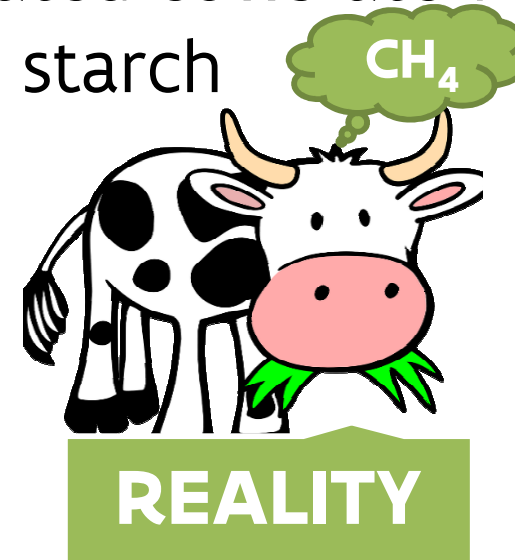
AVEVE Linex grass

- ✓ Trend for lower methane emissions per kg milk
 - No production trial
- ✓ Treated cows ate 1 kg less starch



AVEVE Linex maize

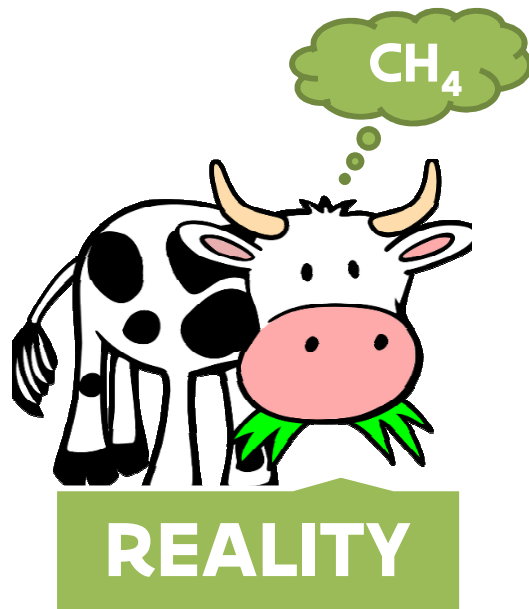
- ✓ 9% lower methane emissions
 - g CH_4 /day
 - g CH_4 /kg DMI
- ✓ Treated cows ate 1 kg less starch



Reality or illusion?

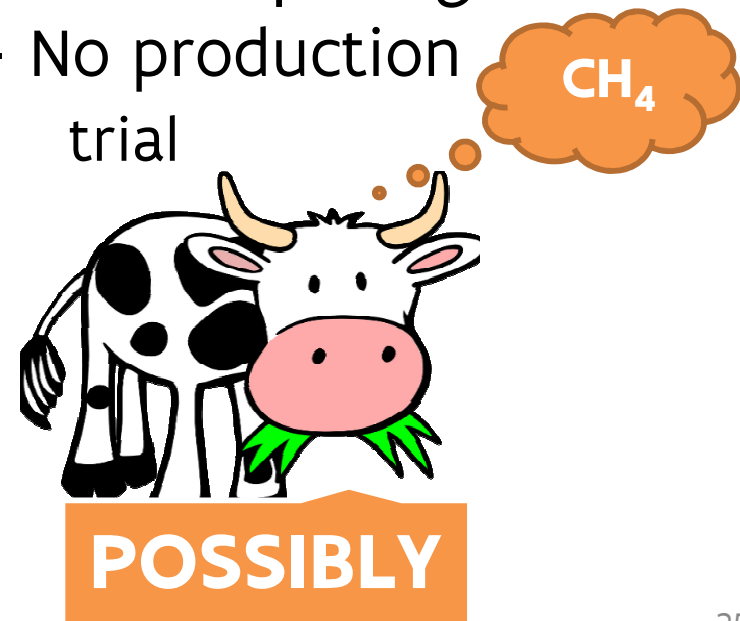
DSM 3-nitrooxypropanol

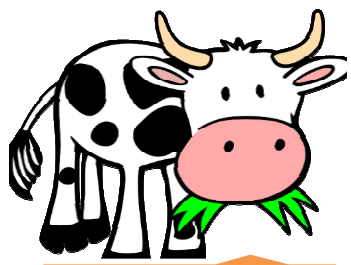
- ✓ 14 – 15% lower methane emissions
 - all CH₄-parameters!



AVEVE Biochem Hopextract

- ✓ Trend for lower methane emissions per kg DMI
- ✓ 14% lower methane emissions per kg milk
 - No production trial





MAYBE

Important remark

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- ✓ 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 or zootechnic trials in dairy stables
 - Is there also methane mitigation in real practice?

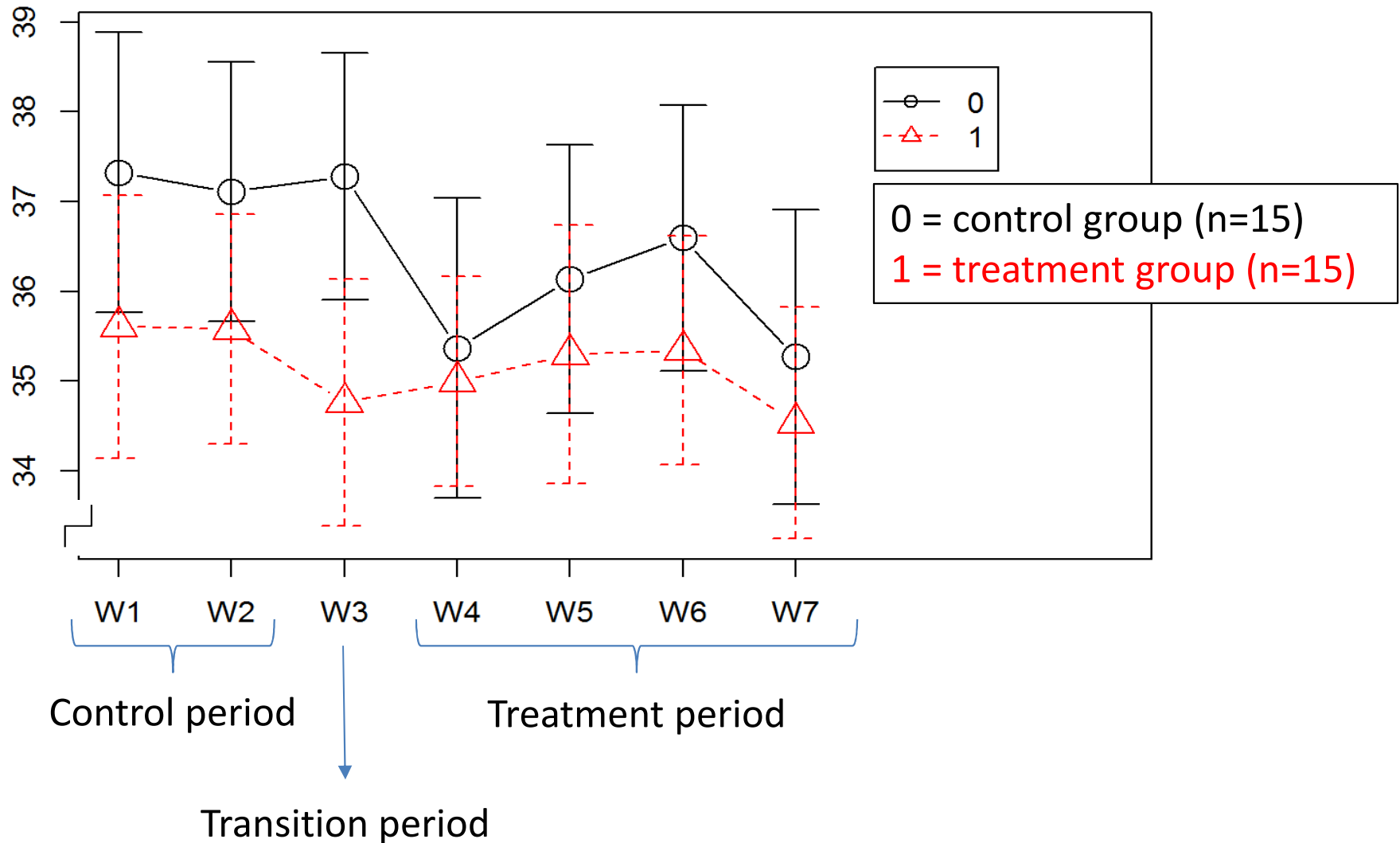
Trial LV Den Hamer

- ✓ Spring 2016
- ✓ AVEVE Linex with ration rich in maize silage on a commercial dairy farm
- ✓ 30 animals in 2 groups

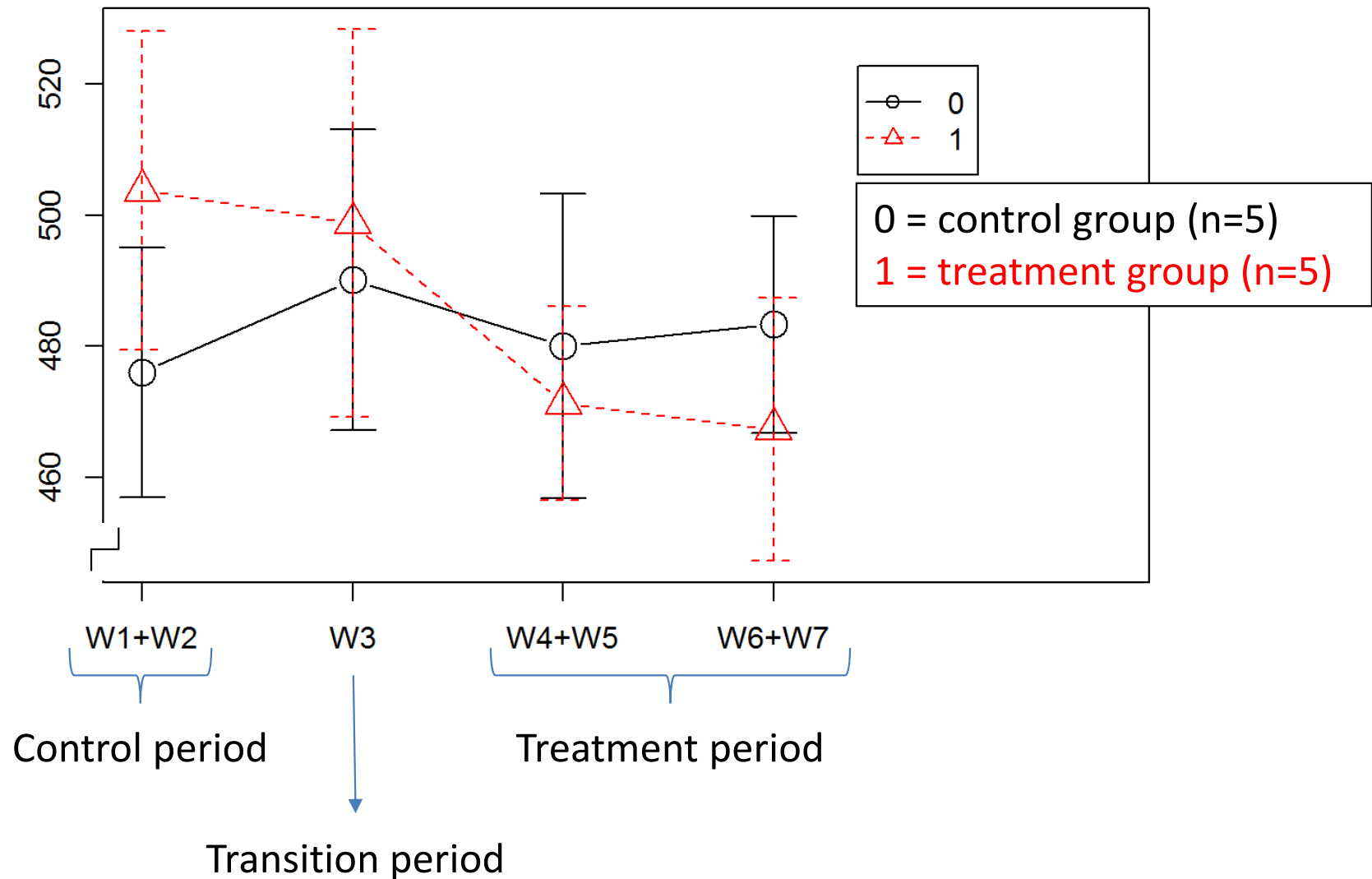
% in roughage mixture (DM)	Trial LV Den Hamer	AVEVE Linex maize
Maize silage	62	65
Grass silage	32	25
Beet pulp or Chicory pulp	6	10

Week	-3	-2	-1	1	2	3	4	5	6	7
	ADAP	ADAP	ADAP	CTRL	CTRL	TRANS	TRTM	TRTM	TRTM	TRTM

Milk production (kg milk/day)



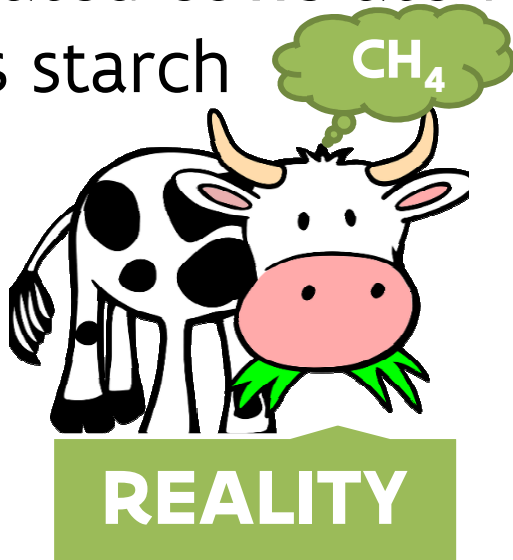
Methane emissions (g CH₄/day)



Reality or illusion?

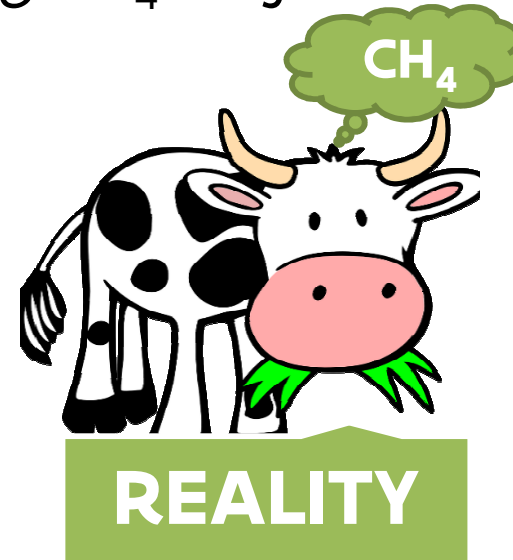
In vivo trial

- ✓ 9% lower methane emissions
 - g CH₄/day
 - g CH₄/kg DMI
- ✓ Treated cows ate 1 kg less starch



Practice

- ✓ Lower ($p=0,03$) methane emissions per kg milk
- ✓ Trend ($p=0,07$) for lower methane emissions
 - g CH₄/day



Zootechnic trial 3-NOP ILVO

✓ Three groups:

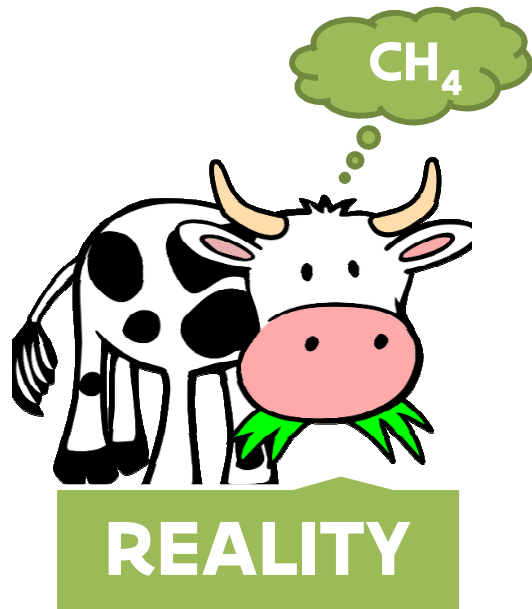
1. Control group (n=10)
2. 3-NOP in roughage mixture (n=10)
3. 3-NOP in pelleted concentrate (n=10)



Reality or illusion?

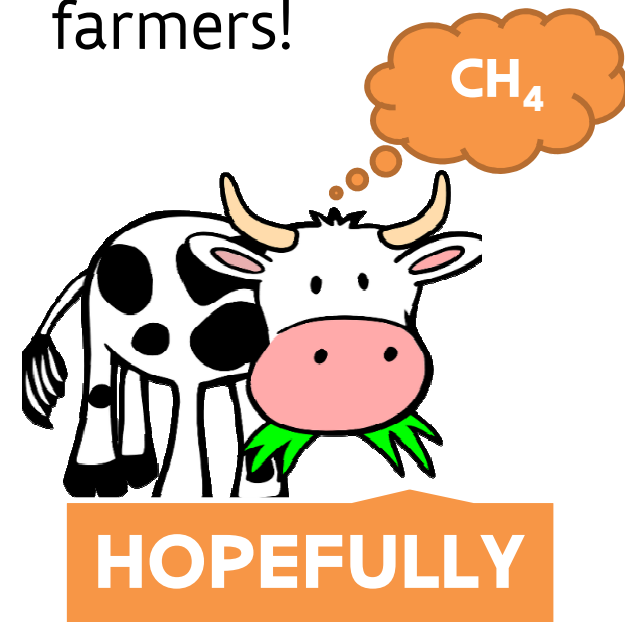
In vivo trial

- ✓ 14 – 15% lower methane emissions
 - all CH₄-parameters!

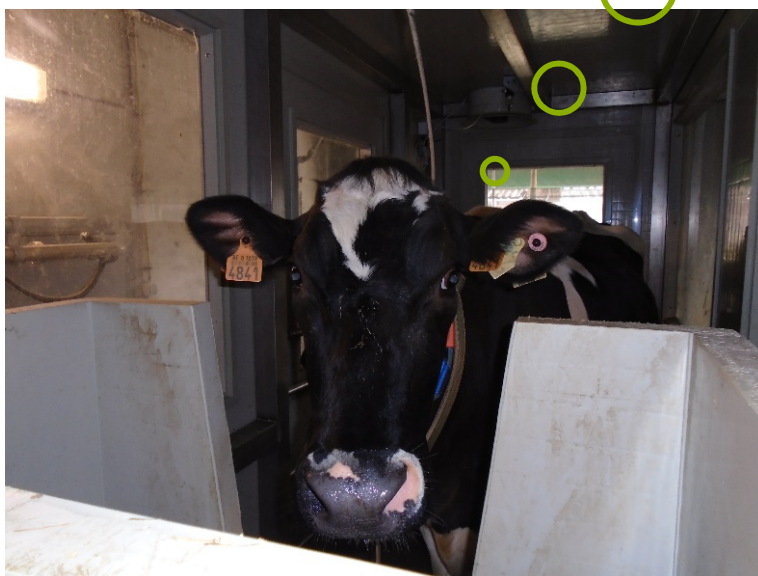


Practice

- ✓ No data yet!
- ✓ This additive is still under development!
 - Not yet available for farmers!



Thank you



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