Low protein feeding as a potential measure to reduce ammonia emissions from beef cattle barns

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trouw aan land- en tuinbouw

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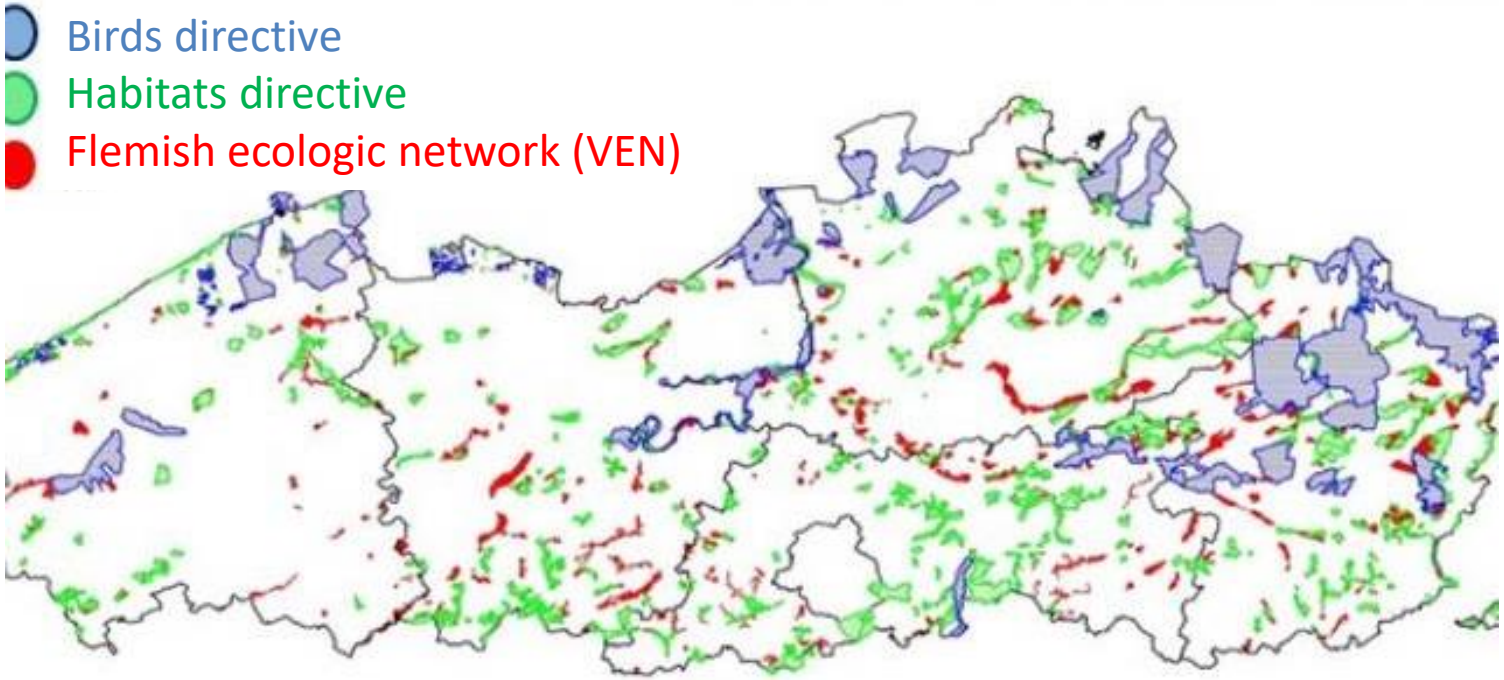
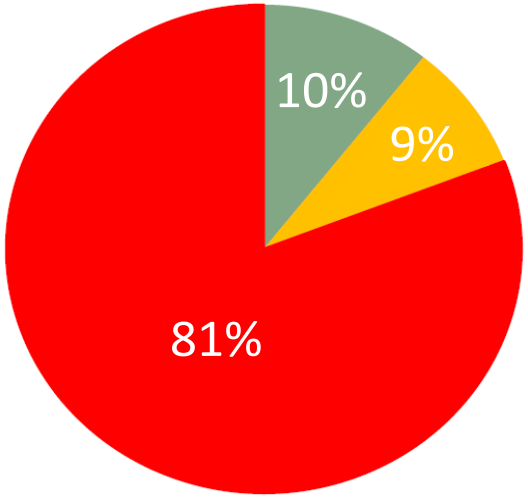
Introduction: the situation in Flanders

62 Natura-2000 reserves in Flanders



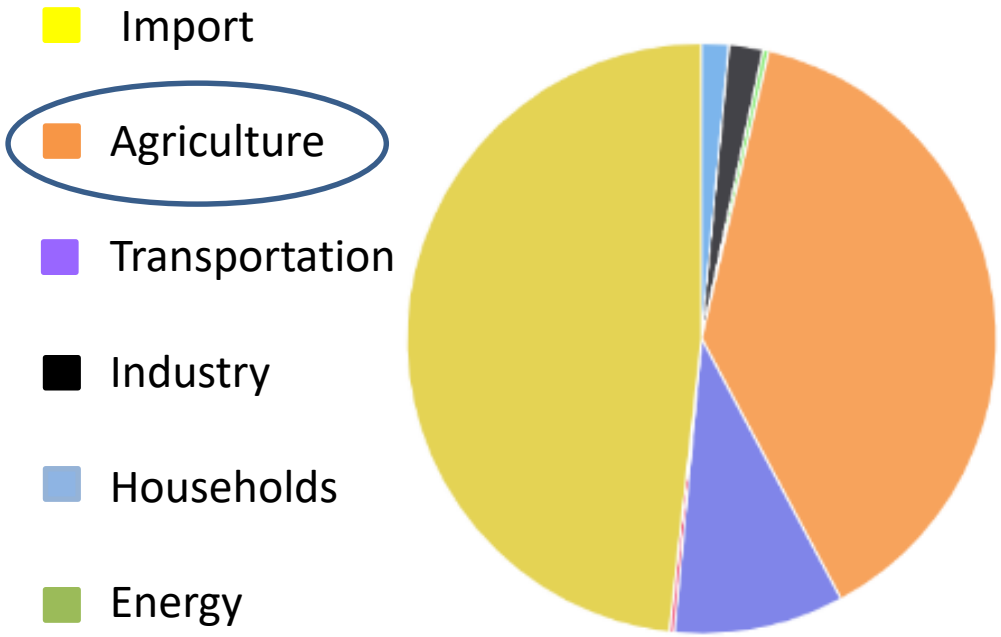


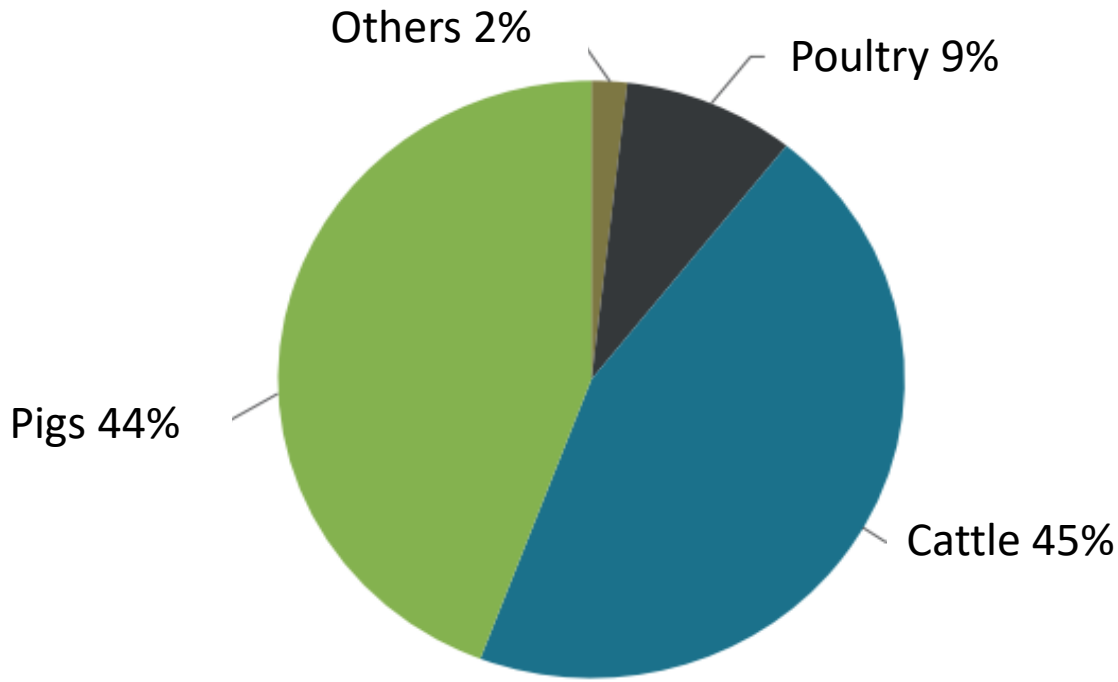
18% of EU's land area

12% of Flemish land area, but very fragmented

Introduction: the situation in Flanders

Sources of ammonia emission





Source: Vlaamse Milieumaatschappij, 2018

Introduction Programmatic Approach on Nitrogen (PAN)

<u>The aim of PAN:</u>

- Decrease the nitrogen deposition on protected nature in Flanders
- Continuation of economic/agricultural activities in these areas

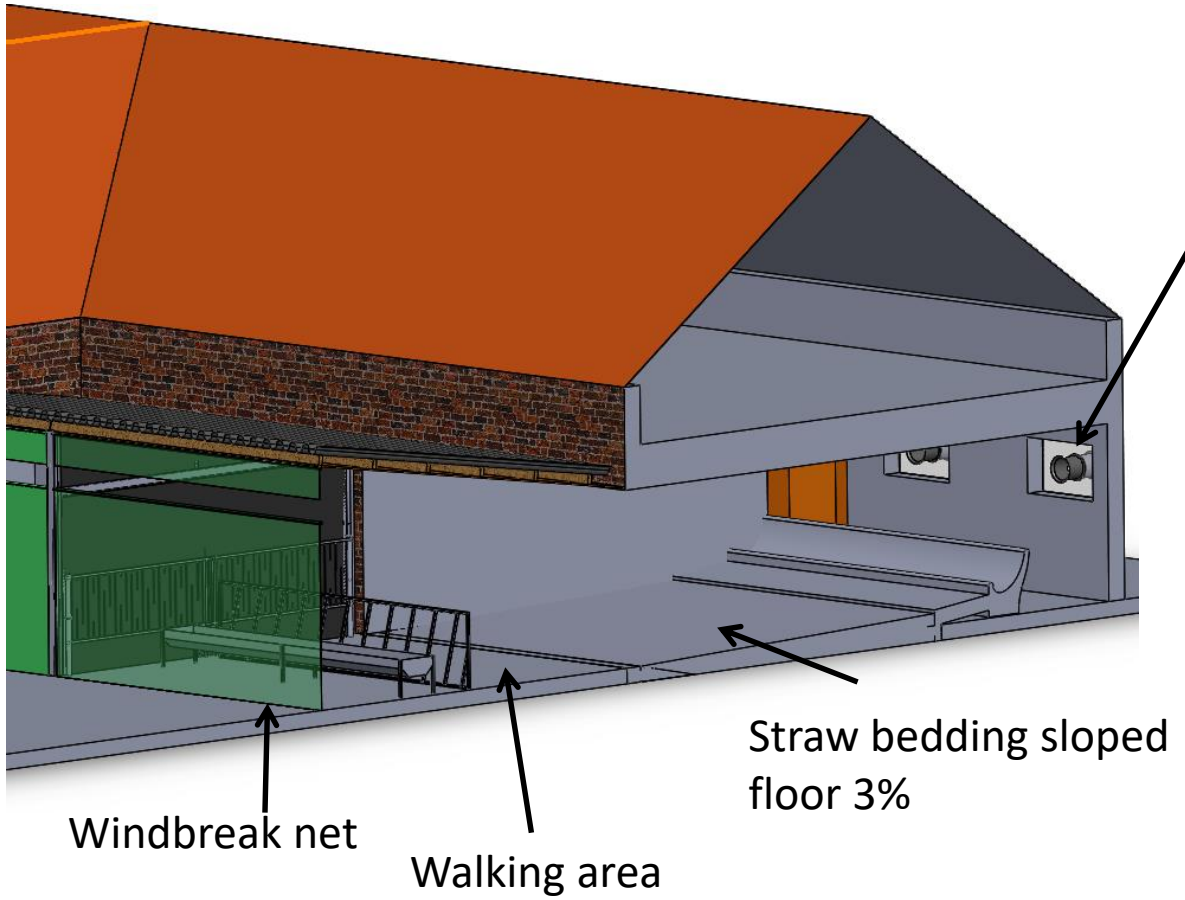
<u>How:</u>

- Each livestock farm received a score indicating the impact of the farm on nearby nature
- In case a reduction is needed → farmers can choose from a list of approved NH_3 reducing techniques
  - Dairy cattle: 27 possible measures
  - **Beef cattle: 1 possible measure: grazing…**

Research objective: Evaluation of low protein feeding as a potential PAN measure

ILVO beef cattle emission barn
4 mechanically ventilated deep litter compartments

Methodology



Fans:

- 2 per compartment
- Rate constantly logged
- NH_3 measurement (Picarro) at each fan

- Detection limit <1ppb (NH3)

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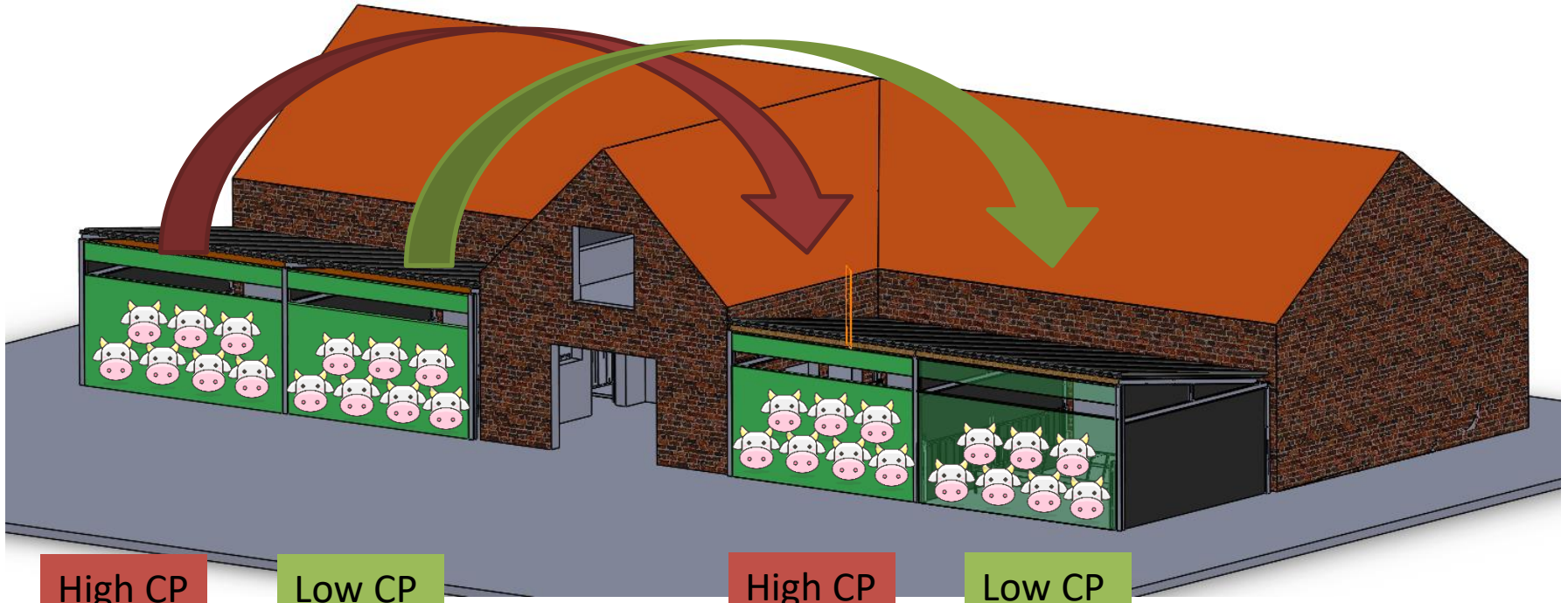
Methodology

Feeding trial with low (L-CP) or high crude protein (H-CP) diet, using 4x7 Belgian Blue heifers over 4 measurement periodes (MP) of 3 weeks

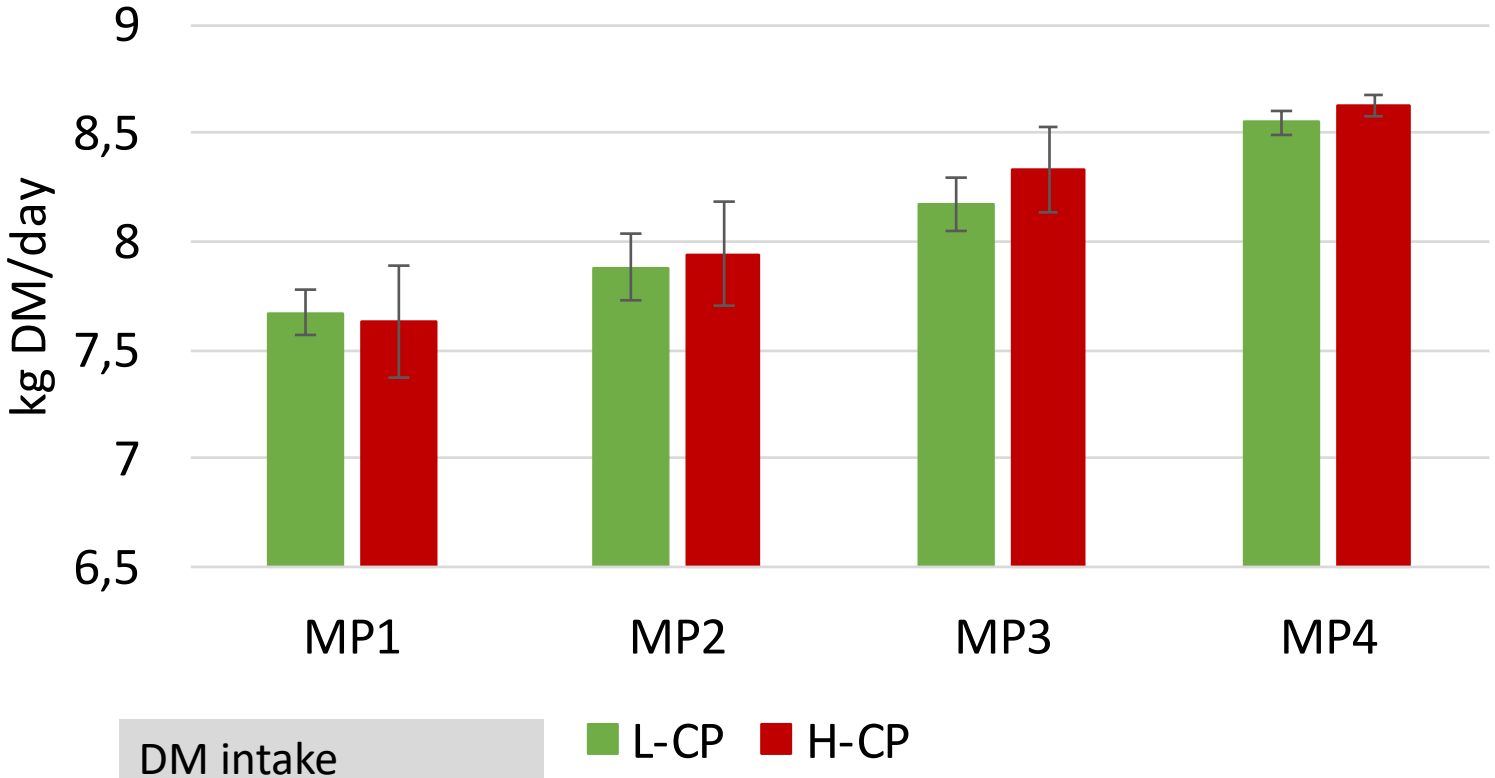


Methodology: dietary composition

% dry matter	Low CP TMR		High CP TMR
Maize silage	44%		43%
Grass silage	43.6%		42.6%
Straw	2.4%		2.4%
Urea	0%		1.0%
Soybean meal	0%		4%
Rumen protected SBM	3%		0
Concentrate	7%		7%
Nutritional Value			
Energy (MJ/kg DM)	**6.09**	**=**	**6.08**
Crude protein %	**11.5%**	**≠**	**14.0%**
PDI (g/kg DM)	**61**	**=**	**58**
RDPB (g/kg DM)	**-15**	**≠**	**+15**

Results

- Dry matter intake (kg/day)



DM intake
Treatment: P > 0.05
Period: P < 0.05

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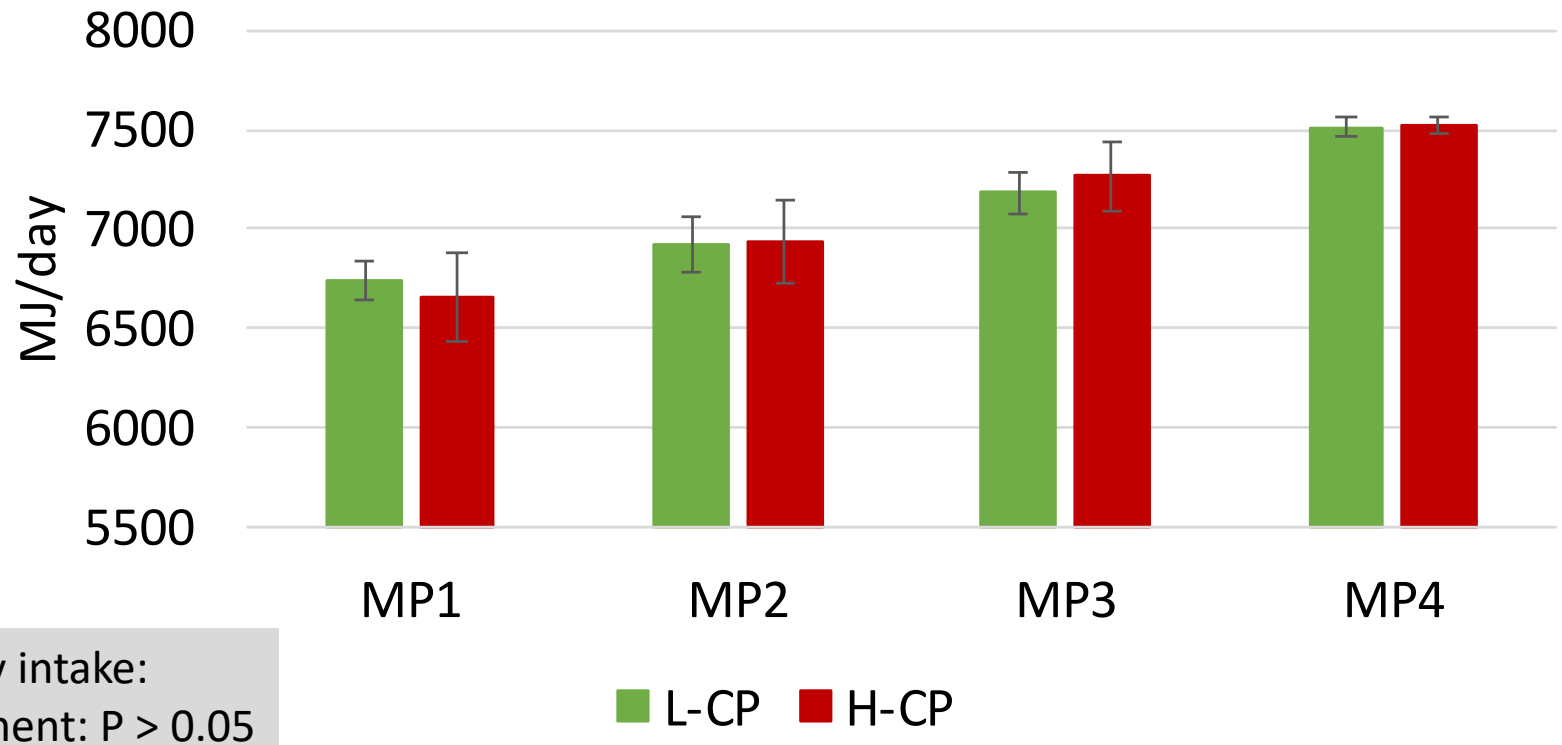
Results

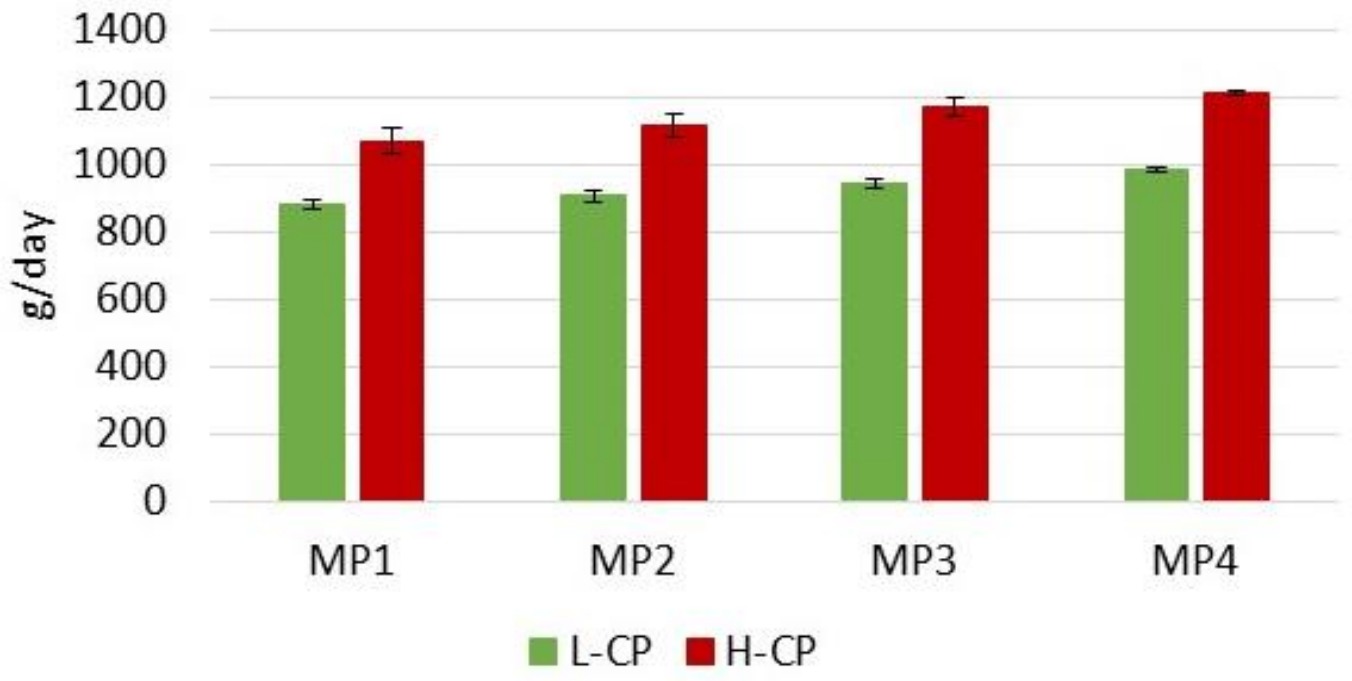
- Energy intake (MJ/day)



Energy intake:
Treatment: P > 0.05
Period: P < 0.05

Results

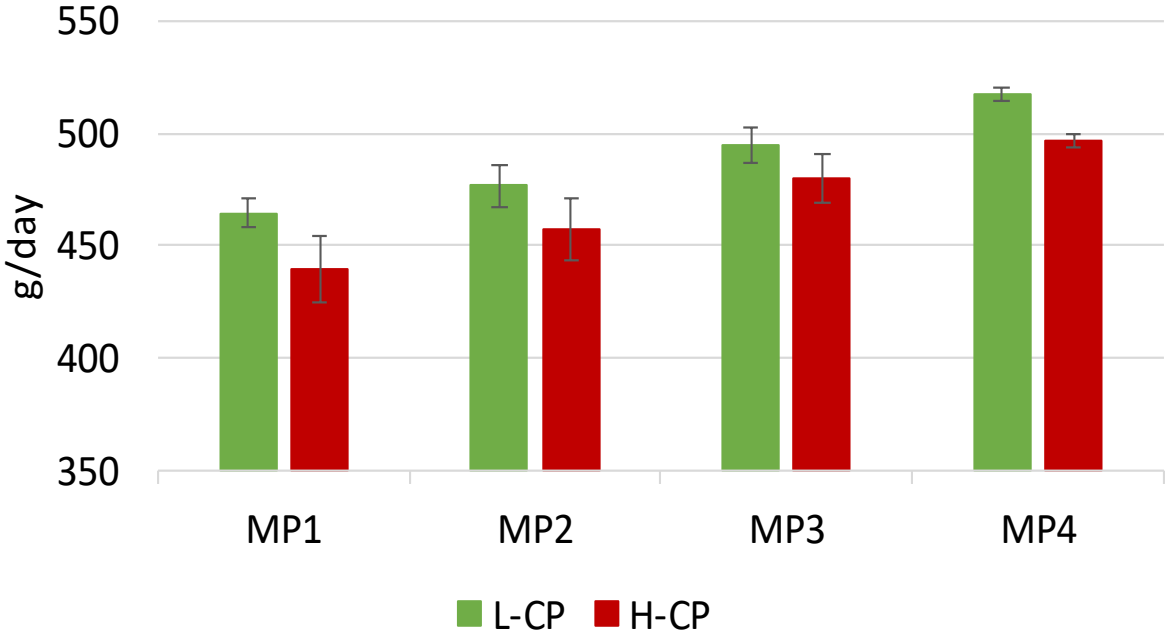
- Crude protein intake (g/day)



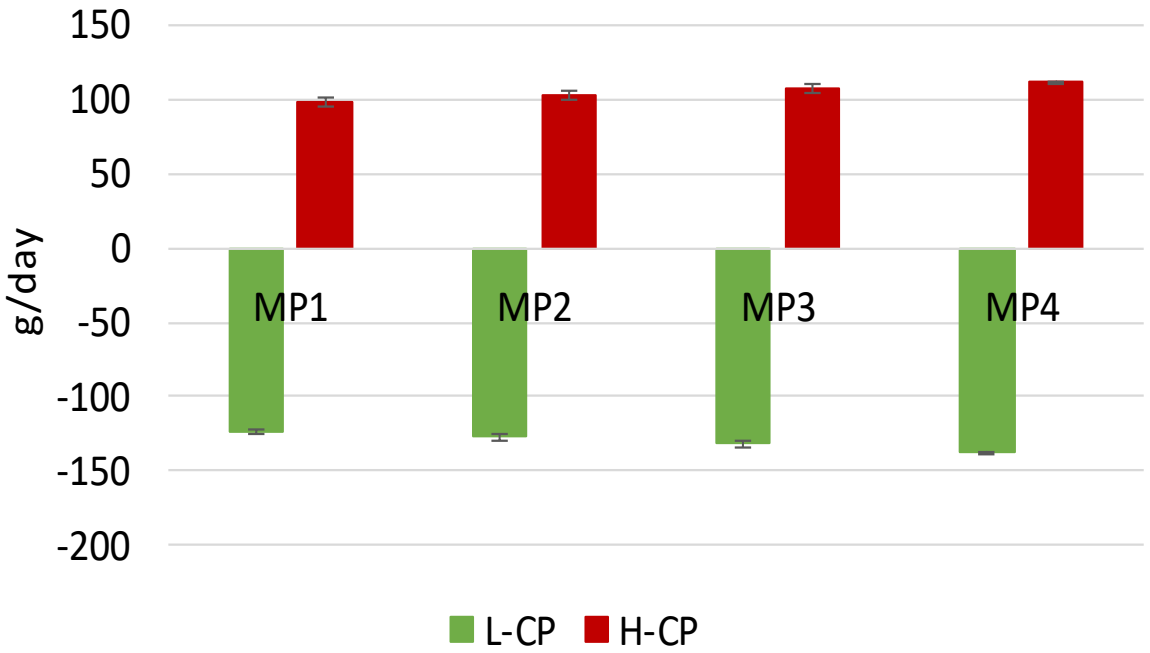
CP intake:
Treatment: $P < 0.001$
Period: $P > 0.05$

Results

- PDI intake and RDPB (g/day)



PDI intake:
Treatment: P > 0.05
Period: P < 0.05



RDPB:
Treatment: P < 0.001
Period: P > 0.05

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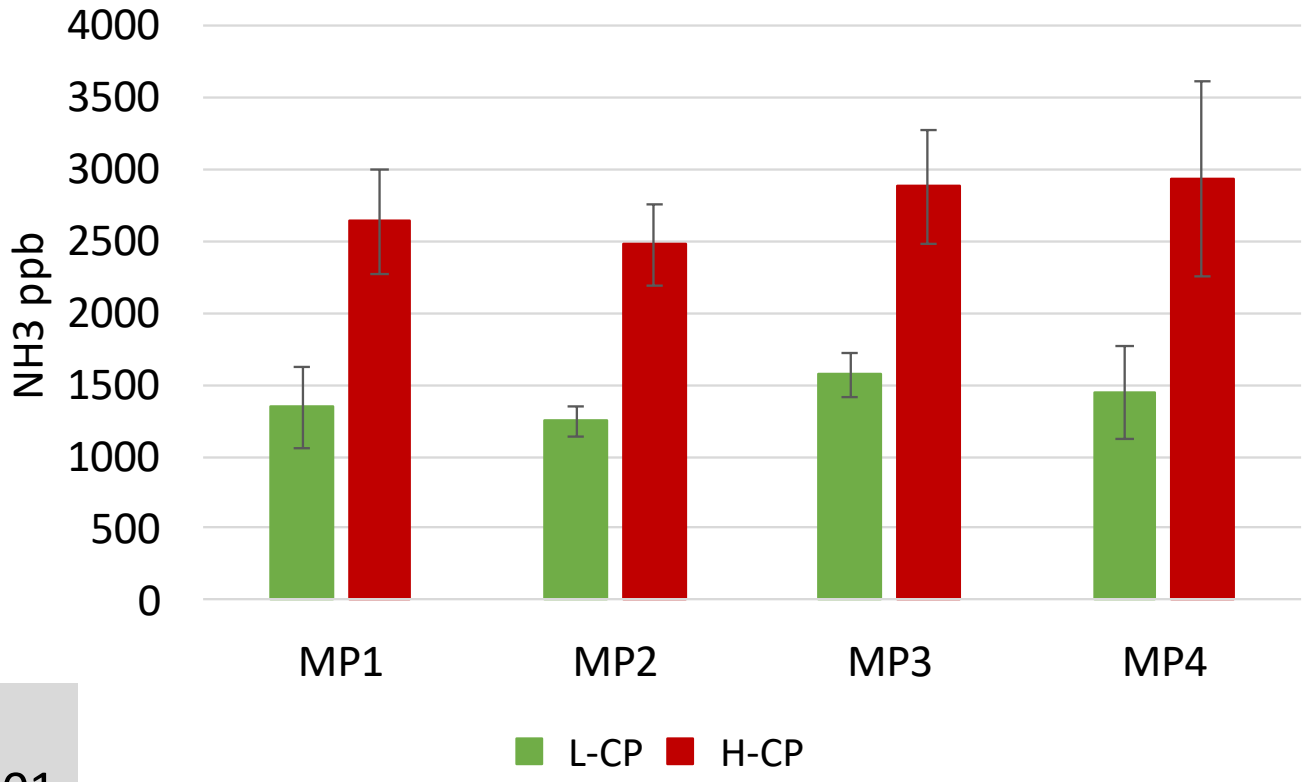
Results

- Ammonia emission (NH_3 concentration in ppb)



Δ = 48.8 ± 2.2%
Treatment: P < 0.001

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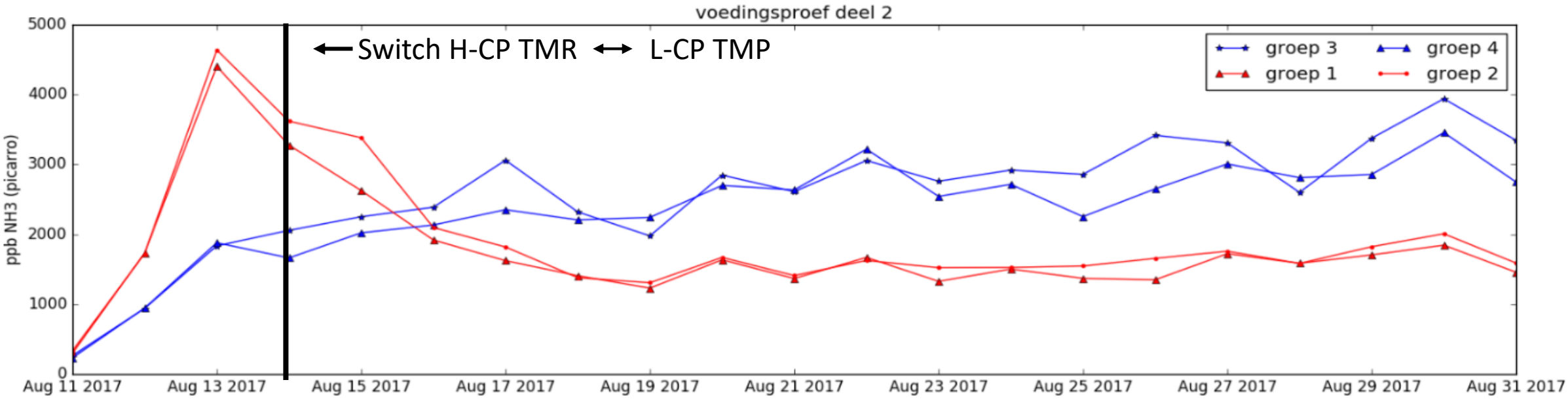
Results

- Ammonia emission (NH_3 concentration in ppb – raw data)



Very fast effect of dietary changes on ammonia emissions

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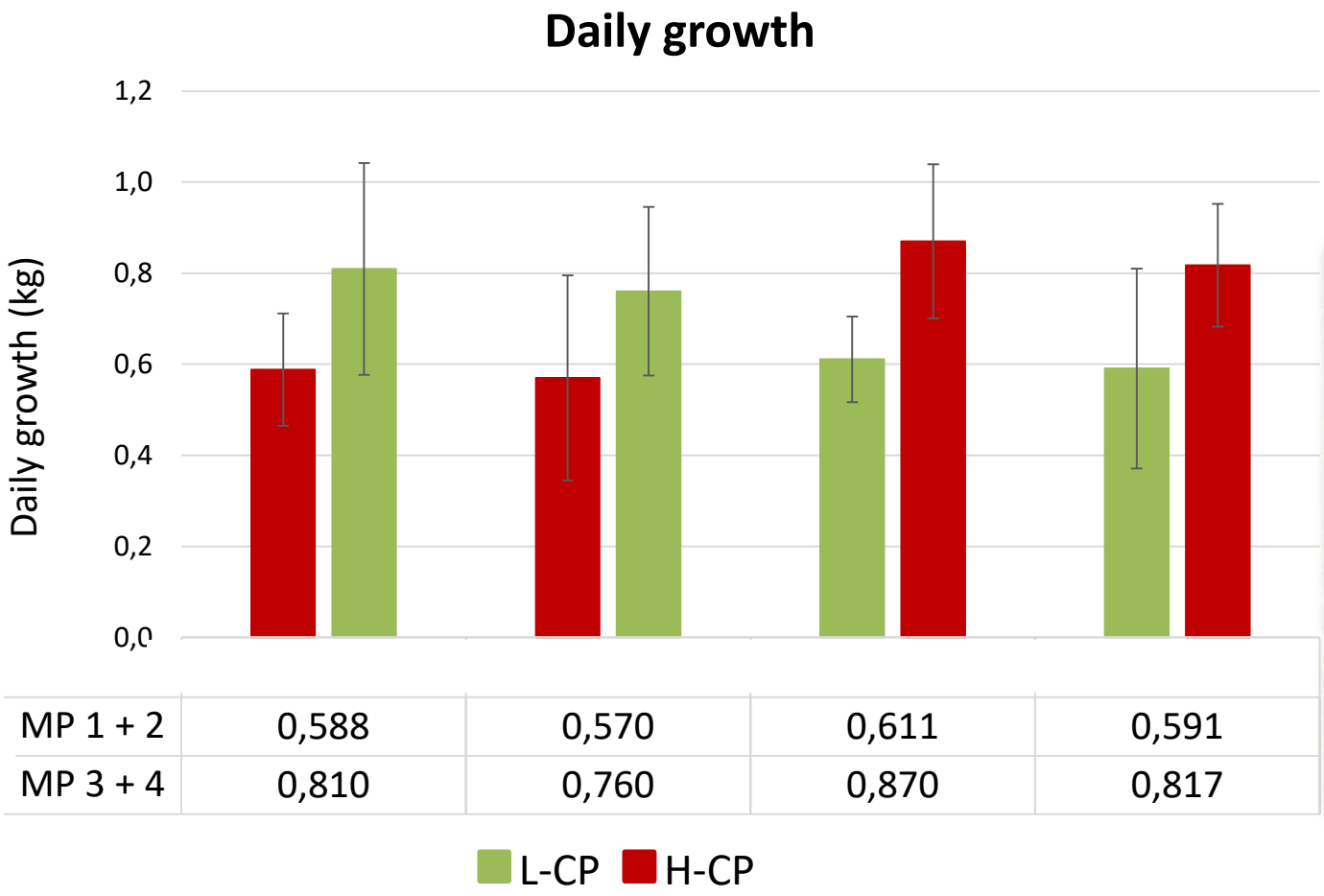
Results

- Urinairy and faecal N excretion

Parameter	L-CP 11,6% RE	H-CP 14,2% RE	P-value Treatment
Urine production L/day	8.3 ± 3.5	8.5 ± 3.2	P > 0.05
Urinairy N g/day	**39.2 ± 11.1**	**64.6 ± 9.6**	**P < 0.001**
Urinairy Ureum N g/day	**21.1 ± 5.8**	**55.5 ± 8.5**	**P < 0.001**
Faeces kg FM/day	16.7 ± 3.9	16.7 ± 2.8	P > 0.05
Faecal N g/day	66.7 ± 14.1	62.0 ± 5.7	P = 0.02

Results: animal performances short term



MP 1 + 2	0,588	0,570	0,611	0,591
MP 3 + 4	0,810	0,760	0,870	0,817

Period: $P < 0.05$
Treatment: $P > 0.05$

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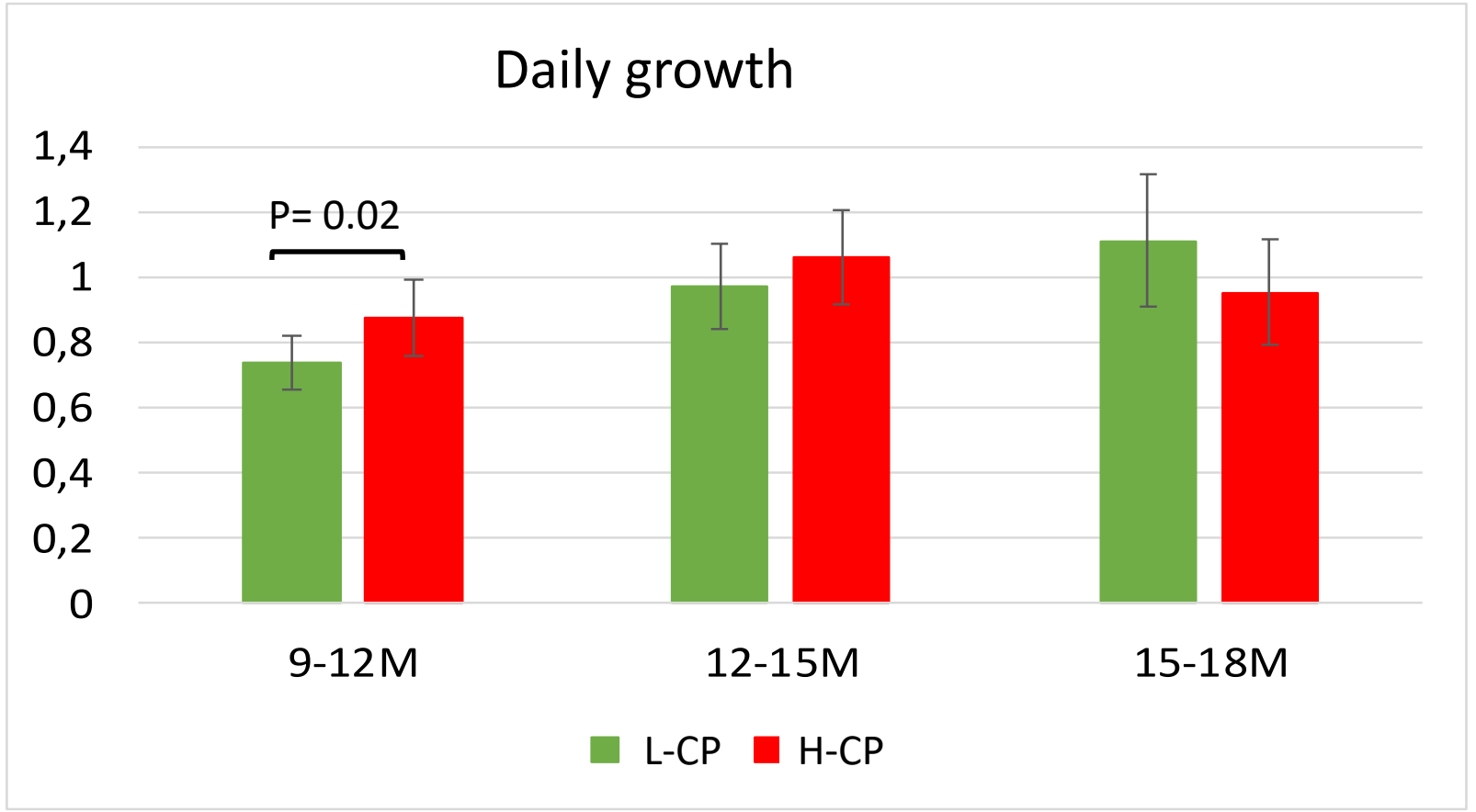
Results: animal performances long term

Parallel experiment: long term study: Daily growth of DMBB heifers on 12% (L-CP) or 14% (H-CP) protein diet between 9 and 18 months of age.

Mean growth kg/day:
L-CP = 0.981 kg/day
H-CP = 0.991 kg/day

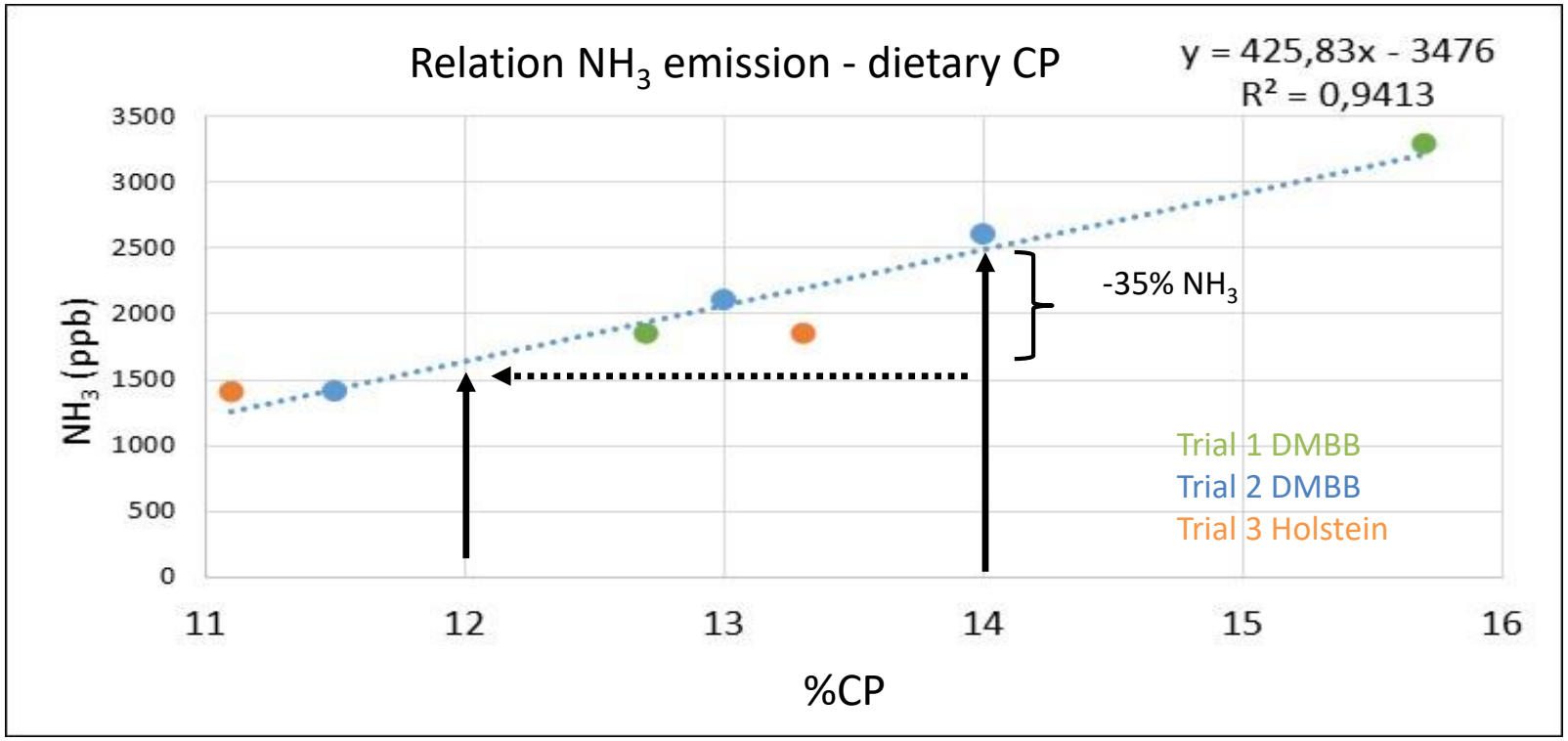
Literature:
DG = 0.750 kg/day

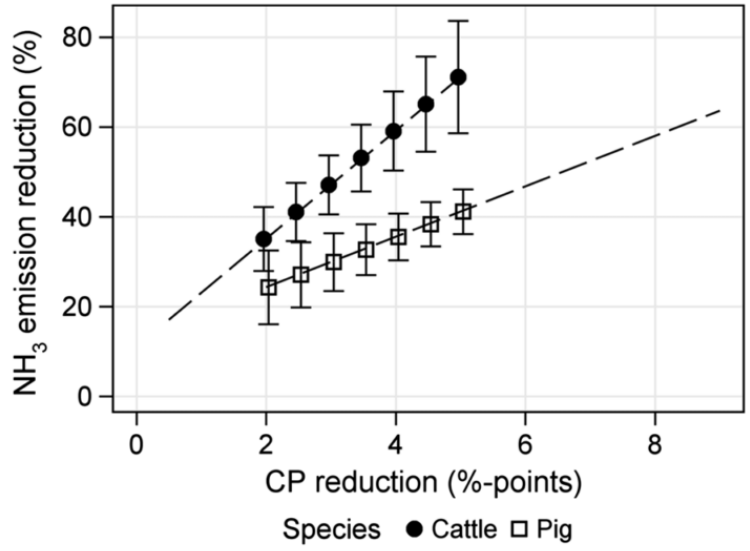


Requirement of 14% CP under the age of 12M, reduction to 12% CP from 12M onwards

Conclusions 1

- An animal trial in a mechnically ventilated straw-bedded stable confirmed the potential of low-protein feeding to reduce NH_3 emissions from cattle barns
- A linear relation was found between the crude protein in the diet and the NH_3 emission from the barn, based on 3 independent animal trials $R^2 = 0.941$





Sajeev et al., 2018

Conclusions 2

- Low CP diet resulted in significantly lower urinairy N and urinairy ureum N concentrations

- A reduction is dietary crude protein for DMBB heifers is possible.
  -For animals < 1 year, a CP level of 14% is advisable.
  -For animals > 1 year, the CP level can be reduced to 12% without negative implications on animal performances (attention for the PDI level!)

- Experiments on bulls with concentrate based diets are under investigations

- How to implement low protein feeding as a controlable PAN measure is still a point of discussion.

Questions?

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