Determination of enteric methane emissions of dairy cows fed with different diets and relationship with milk yield in order to improve advice for farmers

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Introduction

- Methane from ruminal fermentation (enteric methane) : **40%** of total emissions of the agriculture sector *(Gerber et al., 2014)*.
- One possibility to decrease them = improvement of feeding strategies

LIFE **DAIRYCLIM**
Aims to improve feeding strategies regarding methane emissions, carbon footprint and feeding costs
At barn: Test of concentrates of different composition
During the grazing season: Improving of grazing management

Material and methods

- Trials were held in 2 Walloon experimental farms **at barn** and **at grazing**
- **At Barn: Ration offered:**

TMR based on **forages** + **concentrates** of different composition

- 2 groups of Holstein cows with similar days in milk – production level
- 1 received tested concentrate (conc) ⟺ 1 received the control conc

In 2015-2016: Conc rich in Starch vs Control
Conc rich in Fat vs Control
In 2016-2017: Extruded Linseed (ELS) vs Control
Canola seed (CS) vs Control

↗ Starch by 22 %
↗ Fat by 16% 2016
↗ Fat by 33% 2017

Objectives: reach a decrease of methane emissions by **10%**

Measurements :

- Methane ⟹ in breath samples (sniffer method)
  ⟹ analysis of milk spectra => predictions
- Carbon footprint: Feedprint®
- Feeding costs: accountancy + software « Dégâts du Gibier » (Fourrages Mieux)

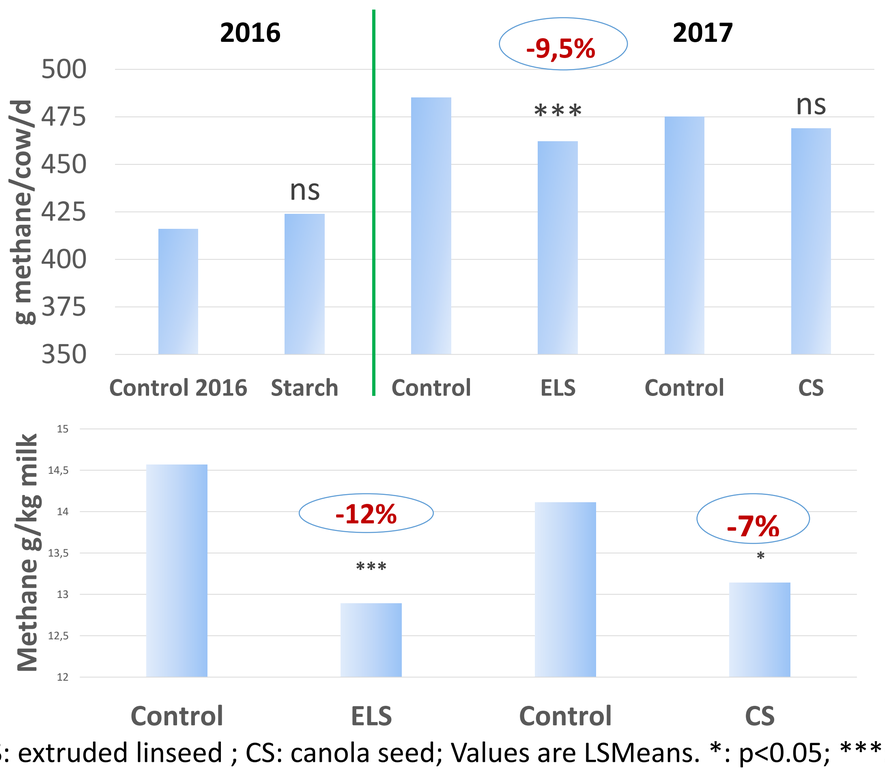
Composition of the diets during the trials

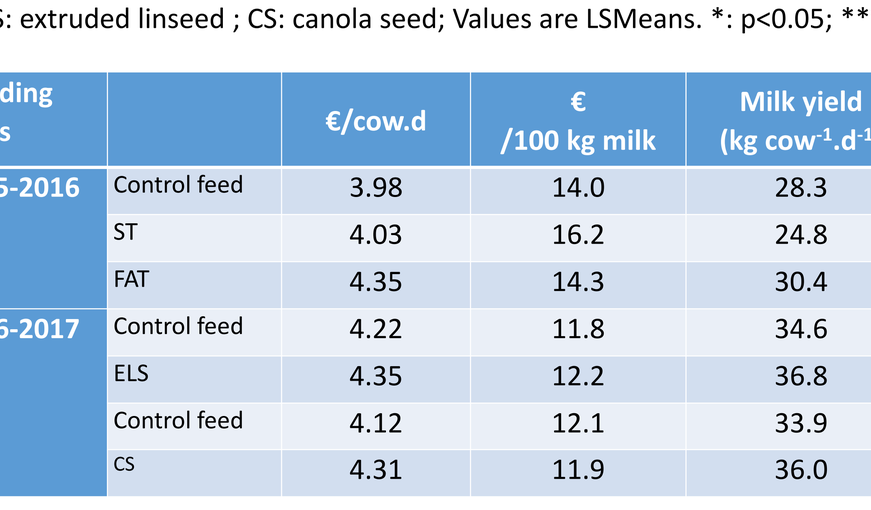
	2015-2016		2016-2017	
% DMI	ST vs control	Fat vs control	ELS vs control	CS vs control
Forages	60	56	59	56
By - products	14	13	11	14
Conc. rich in protein	9	9	9	9
Concentrate	17	22	21	21
Total DMI	**19.5 kg**	**20.6 kg**	**24.6 kg**	**24.1 kg**

Abbreviations DMI: dry matter intake ; ST: starch; ELS: extruded linseed ; CS: canola seed

Results

Methane emissions





Abbreviations ELS: extruded linseed ; CS: canola seed; Values are LSMeans. *: p<0.05; ***:p<0.01

Feeding costs

Feeding costs		€/cow.d	€ /100 kg milk	Milk yield (kg cow^{-1}.d^{-1})
2015-2016	Control feed	3.98	14.0	28.3
	ST	4.03	16.2	24.8
	FAT	4.35	14.3	30.4
2016-2017	Control feed	4.22	11.8	34.6
	ELS	4.35	12.2	36.8
	Control feed	4.12	12.1	33.9
	CS	4.31	11.9	36.0

On pastures:

Objectives: comparing the effects of different grazing management

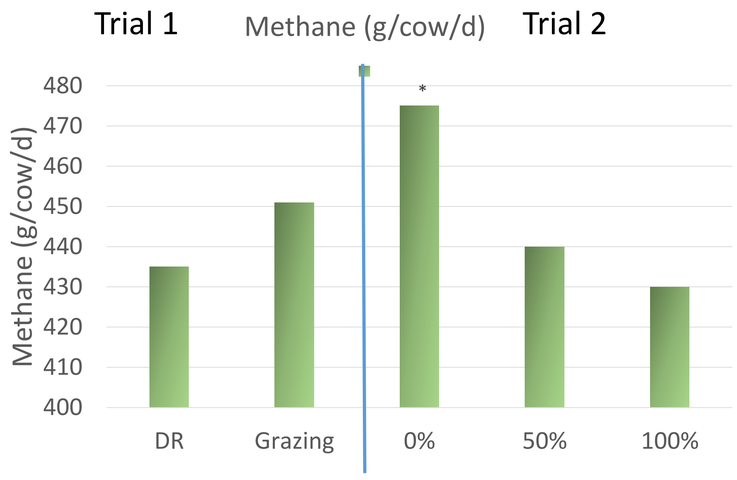
- **Trial 1** Comparison 0% grazing – dry ration (DR) vs 100% grazing
- **Trial 2** Comparison 3 diets: 0%, 50% and 100% grazing

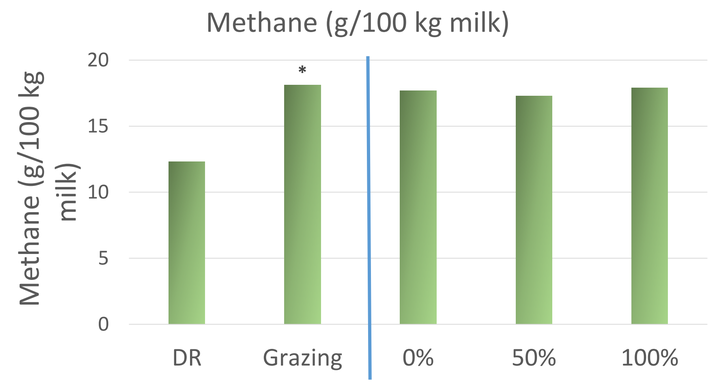
Composition of the diets during the trials

	Trial 1		Trial 2		
% DMI	DR	100%	0 %	50%	100%
Forages	24.8	-	78.8	35	-
Barley	-	-	4.2	4	-
By-products	3.7				
Concentrate	71.5	16.1	17	11	9
Grazed grass	-	83.9	_	50	91
Total DMI	21.4	18	21,6	20,4	19,8

Results

Methane emissions





Abbreviations DR: dry ration; Values are LSMeans. *: p<0.05

Feeding costs

Feeding costs		€/cow.d	€ /100 kg milk	Milk yield (kg cow^{-1}.d^{-1})	%
2016-2017	DR	5.93	16.5	36.3	
	Grazing	1.98	8.0	26.1	**48%**
2017-2018	0%	4.73	16.6	28.5	
	50%	3.36	12.3	27.2	**74%**
	100%	2.19	8.7	25.2	**52%**

Lower difference in 2018 due to lower grass yield

Climate impact

Year of trial	Tested diet	g eq CO2/kg milk	g eq CO2/kg ECM
2015-2016	Control	269	283
	ST	308	323
	Control	234	274
	Fat	256	274
2016-2017	Control	308	312
	ELS	315	318
	Control	297	307
	CS	311	323
On pastures			
Trial 1	DR	498	576
	Grazing	356	390
Trial 2	0%	363	377
	50%	339	362
	100%	322	353

Abbreviations DR: dry ration; ST: starch; ELS: extruded linseed; CS: canola seed

Conclusion

Diminution in enteric methane with concentrates rich in Fat
Depends on the % fat - nature of components: ELS > CS
Grazing: no increase in methane in our study: high grass quality?
Grazing: decrease of feeding costs in relation with % grazed grass
Climate impact: variable impact => positive impacts could be counteracted by negative ones = **to be considered in decision making!!!!**

Gerber P.J., Steinfeld H., Henderson B., Mottet A., Opio C., Dijkman J., Falucci A., Tempio G. (2014) Lutter contre le réchauffement climatique grâce à l'élevage. Une évaluation des émissions et des opportunités d'attenuation au niveau mondial. Organisation des nations Unies pour l'alimentation et l'agriculture.
Vanlierde A.. Vanrobays. M. L.. Gengler. N.. Dardenne. P.. Froidmont. E.. Soyeurt. H.. ,Dehareng. F. (2016). Milk mid-infrared spectra enable prediction of lactation-stage-dependent methane emissions of dairy cattle within routine population-scale milk recording schemes. *Animal Production Science*. 56(3). 258–264. https://doi.org/10.1071/AN15590