Potential of plants from Auvergne region to reduce methane emissions and nitrogen excretion by dairy cows

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Context

01.

World action on methane to keep a 1.5°C future within reach

Global Methane Pledge: **-30%** reduction in methane (2030/2020)

Fit for 55 : reducing EU emissions by at least -**55%** by 2030

Social responsibility approaches in the milk and meat sectors

02.

Enteric methane, specific to ruminants

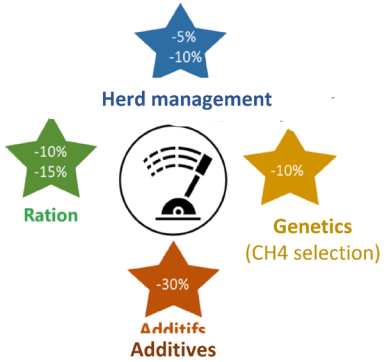
Enteric Methane

- ≃ 50% of GHG emissions from herbivorous livestock farms
- ≃ 5% of European GHG emissions

03.

4 different ways of reduction

A multidisciplinary approach



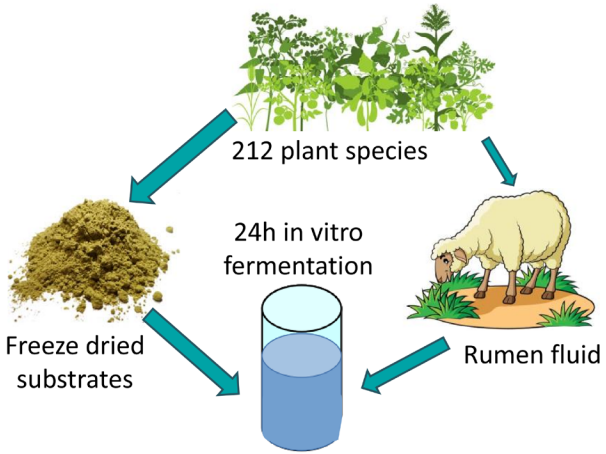
Potential of -50%

Source: Méthane 2030

Objective

Reducing enteric methane emissions (CH4) and nitrogen (N) excretion by introducing local Auvergne plants into dairy cow diets

→ Plants were selected for their ability to reduce CH4 and N based on preliminary ***in vitro*** tests and for their richness in polyphenols (Macheboeuf et al., 2014)



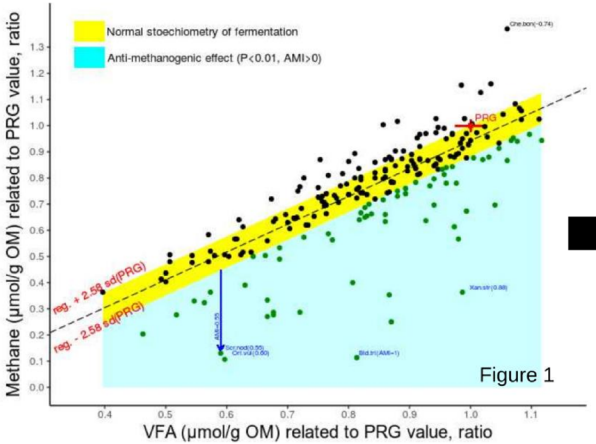


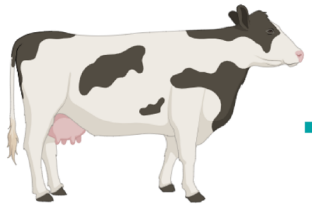
Figure 1

Selection of 6 plants on

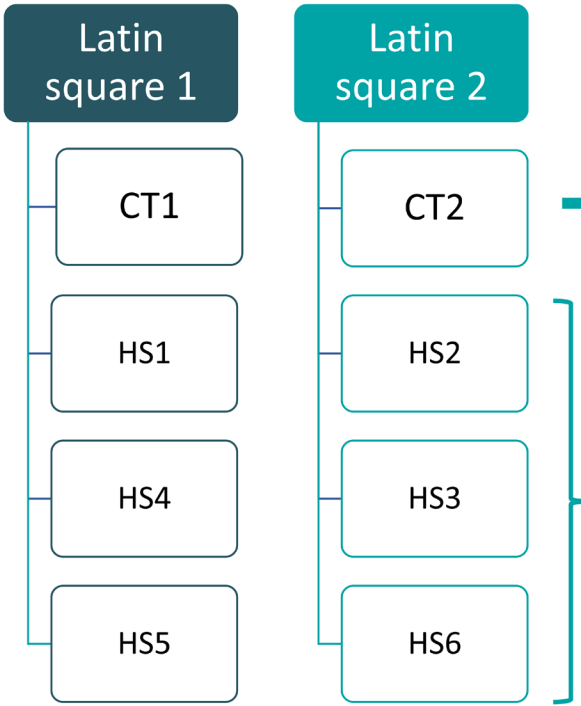
AMI index

(Anti-Metagenomic Index) for *in vivo* test on dairy cows

Materials and methods



- 8 Primiparous dairy cows
- Fed twice daily
- 2 latin squares (LS) : 4 x 4



- **Control diet (CT)**

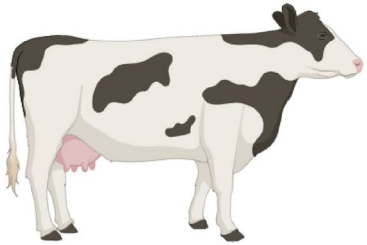
70% fodder

30% concentrate

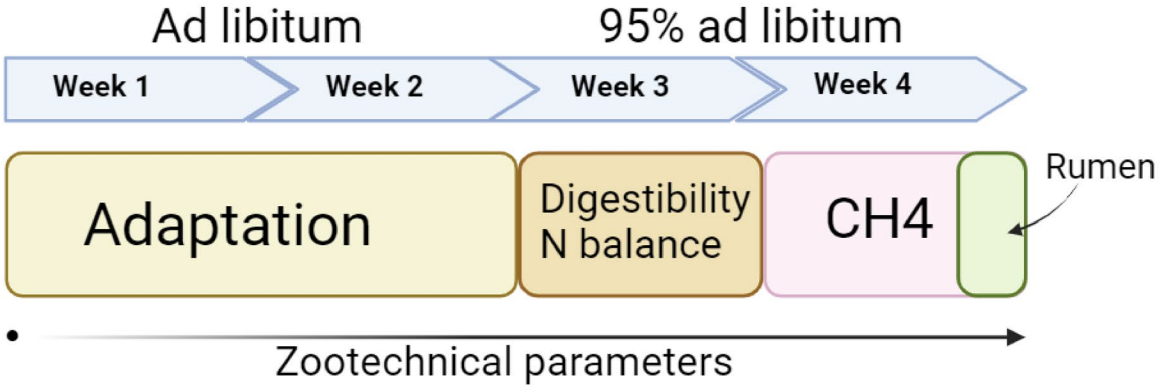
+

- CT + 100 g Herbal Supplement (HS)

Materials and methods



N=4



Materials and methods

- The two Latin squares were analyzed individually
- Statistical analyses were performed using **ANOVA with the MIXED procedure of SAS**
- Model:

$$Y_{ijk} = \mu + Period_i + Herbal\ Supplement_j + Cows_k + \varepsilon_{ijk}$$

Fixed effect of the period
i = 4

Fixed effect of the herbal supplement
j = 4

Random effect of the Cows
k = 4

- **Kinetic analysis of CH4 emissions : Mixed ANOVA with repeated measures**
- Model:

$$Y_{ijk} = \mu + Time_i + Herbal\ Supplement_j + Cows_k + (Time \times Herbal\ Supplement)_{ij} + \epsilon ij_k$$

- Multiple comparison test : Tukey-Kramer ($p<0.05$)

Results on animal performances

	Latin Square 1							Latin Square 2					
	CT1	HS1	HS4	HS5	SEM	P ≤		CT2	HS2	HS3	HS6	SEM	P ≤
DMI (kg/d)	21.6	22.2	21.9	21.9	0.35	NS		20.9	20.4	21.2	20.9	0.86	NS
Milk (kg/d)	27.7^{A}	26.6^{B}	26.9^{AB}	27.3^{AB}	0.81	**0.05**		26.5	26.7	26.7	26.9	1.62	NS
Feed efficiency (kg milk/kg DMI)	1.28^{A}	1.20^{C}	1.22^{BC}	1.25^{AB}	0.033	**0.001**		1.27	1.31	1.26	1.29	0.071	NS

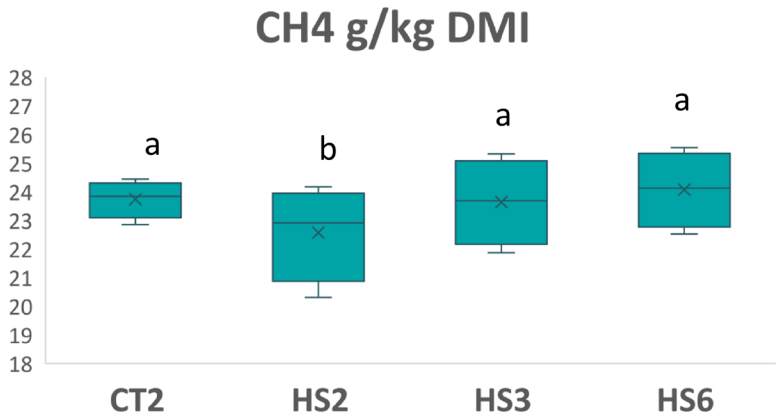
No significant effect of HS on animal performances

Except HS1 which decreased milk production and feed efficiency

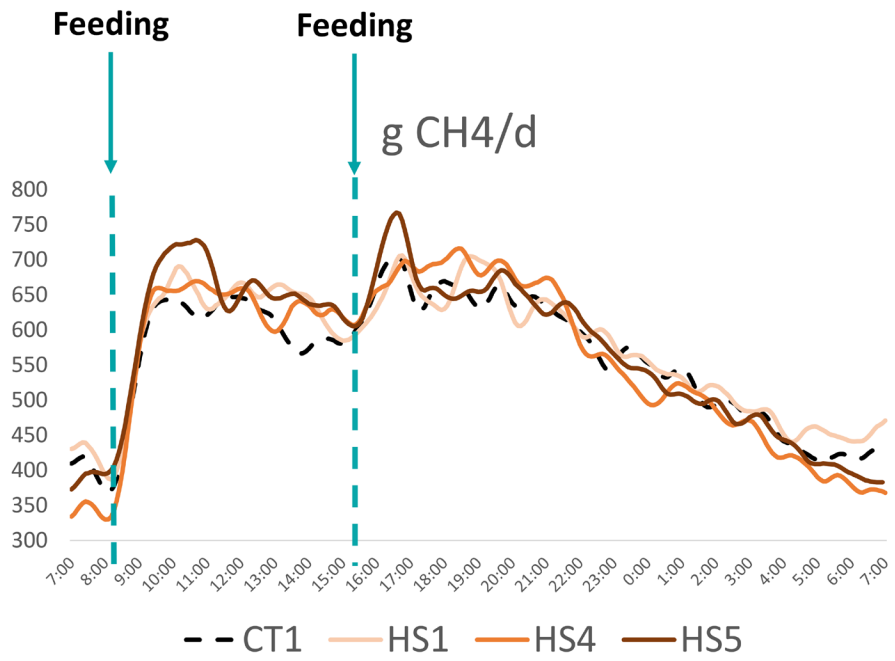
Results on CH4 emissions

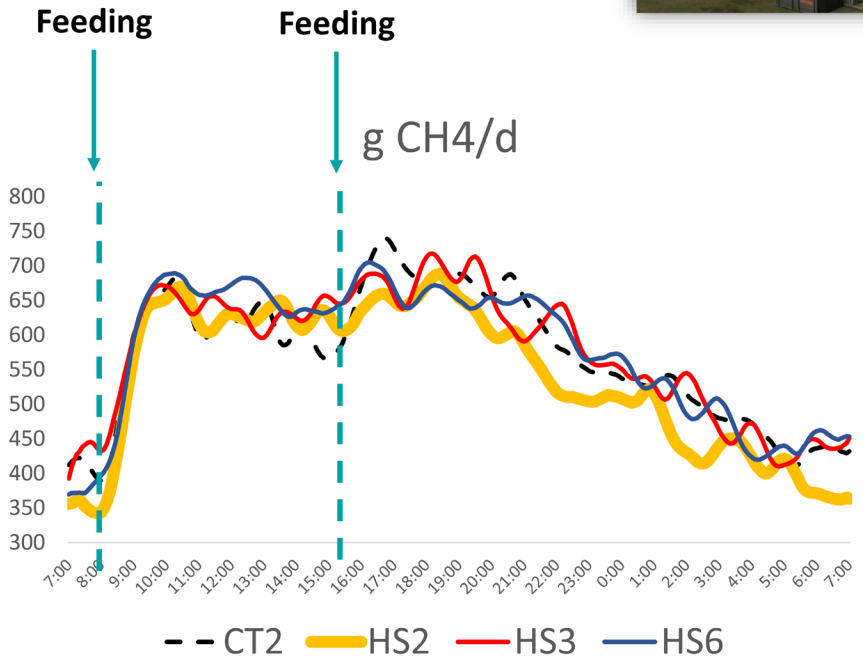
	Latin Square 1							Latin Square 2					
	CT1	HS1	HS4	HS5	SEM	P ≤		CT2	HS2	HS3	HS6	SEM	P ≤
g CH4/d	495	485	475	489	25.2	NS		492	461	497	496	18.1	**0.1**
g CH4/kg DMI	23.3	22.2	22.0	22.5	1.21	NS		23.7^{A}	22.6^{B}	23.6^{A}	24.1^{A}	0.57	**0.001**
g CH4/kg FPCM	17.9	18.2	17.9	18.2	0.65	NS		18.3	17.3	18.4	18.4	0.60	NS

HS2 decreased CH4 emissions :
-7% in g/d
-4% in g/DMI



Results on daily kinetic of CH4 emissions

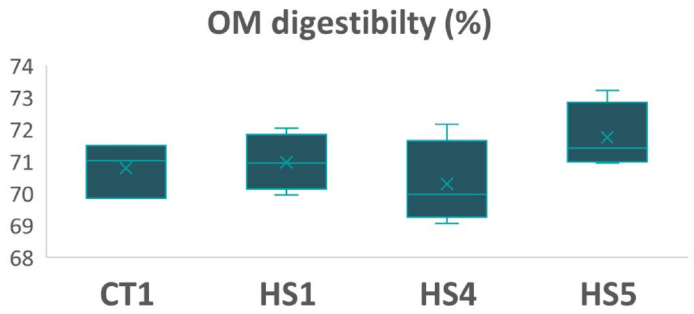


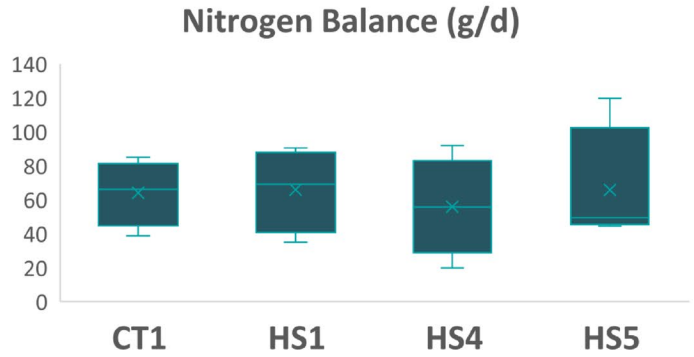


HS2 decreased CH4 emissions mainly after 2nd feeding

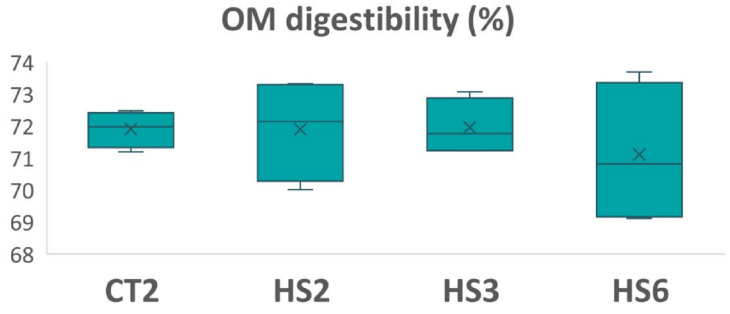
Results on Digestibility and N balance

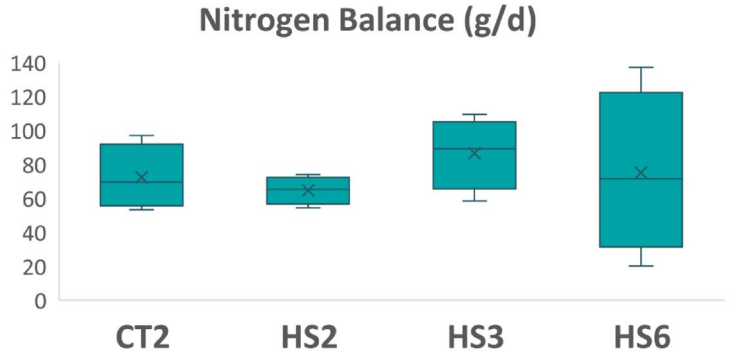
Latin Square 1





Latin Square 2





No effect of HS on nutrients digestibility and N balance

Discussion

Overall effects: the 6 plants studied had few significant effects on the parameters measured on dairy primiparous cows → ≠ in vitro (Macheboeuf et al, 2014)

- **HS1:** decrease in feed efficiency related to a slight reduction of milk production

- **HS2:** significant reduction in CH4 emissions by -7% in g/d to -4% in g/DMI particularly after pm feeding (up to -20%)

Future recommandations

To validate HS2 effect on field condition

- Larger number of animals
- Other form of distribution (e.g., pellet)

To characterize the molecules in the plant responsible for their anti-CH4 activity

- Optimization of sourcing and effective dose

THANK YOU FOR YOUR ATTENTION

Results of ruminal parameters

	Latin Square 1							Latin Square 2					
	CT1	**HS1**	**HS4**	**HS5**	**SEM**	**P ≤**		**CT2**	**HS2**	**HS3**	**HS6**	**SEM**	**P ≤**
Total VFA (mmol/L)	127	126	124	137	4.4	0.1		123	123	128	124	9.1	NS
Acetate (mmol/L)	87.2	86.2	86.2	93.8	3.18	NS		83.5	83.5	87.0	84.2	6.05	NS
Propionate (mmol/L)	22.7	23.7	22.0	24.7	0.96	NS		22.8	22.6	23.2	22.7	2.10	NS
Butyrate (mmol/L)	12.5	11.5	11.2	13.2	0.77	NS		11.5	12.0	13.1	12.3	0.82	NS
Total Protozoa (log_{10}/mL)	5.18	5.01	4.95	5.01	0.087	NS		5.01	5.14	5.09	5.05	0.092	NS

HS had no effect on ruminal parameters

-> except a tendency in total VFA increase for HS5