

# Algae for reducing methane from dairy cows: what expectation with French local resources?

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# Methane is ½ of milk carbonfootprint

Efficient and multiple solutions for reducing methane emissions



**Herd management**



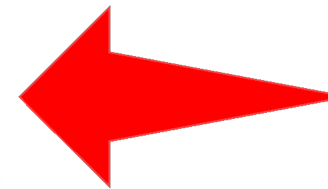
**Diet composition**



**Genetic**



**Additives**



# Seaweed: a promising solution

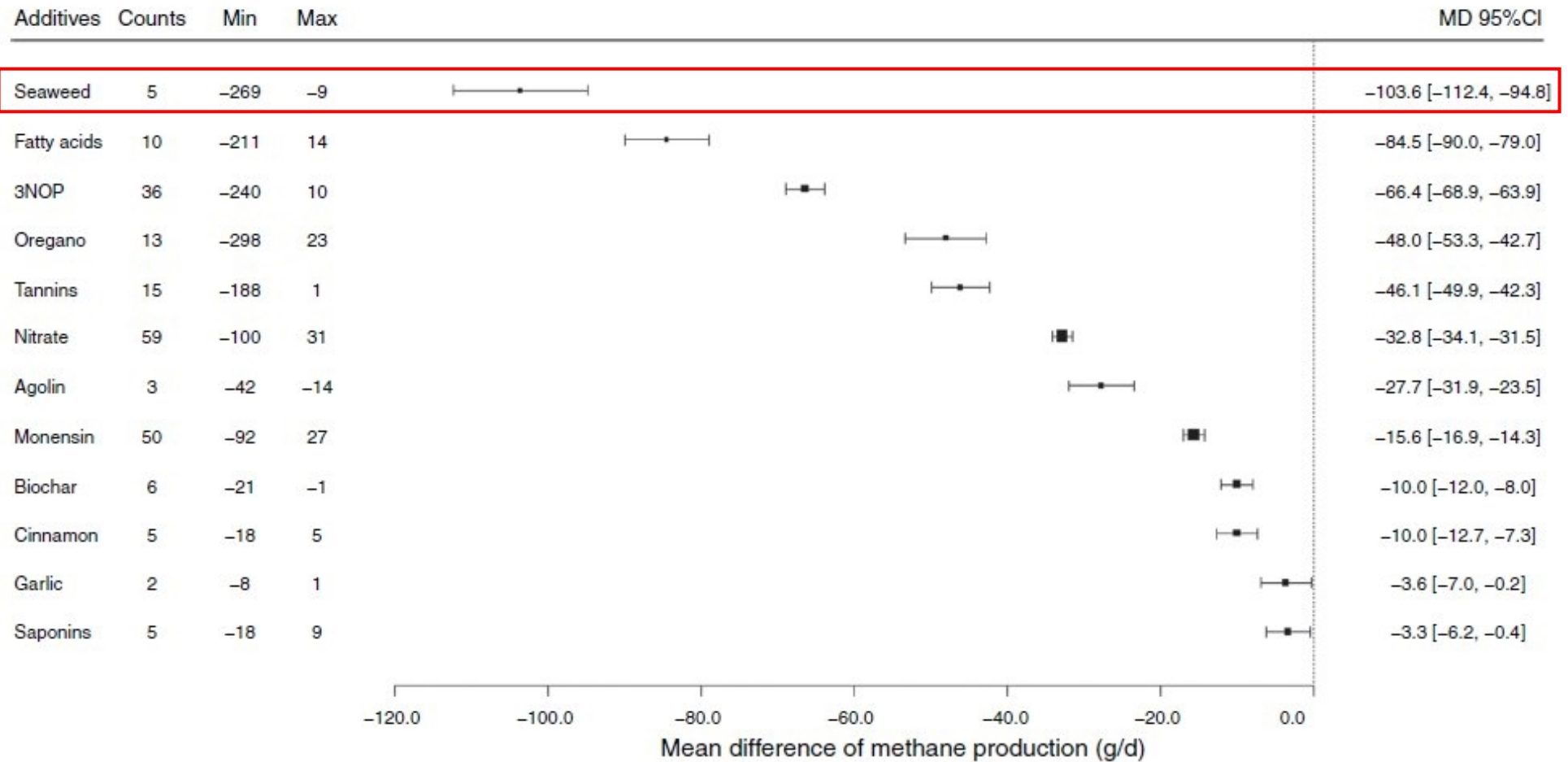


Fig. 2. Forest plot of mean difference (MD) of methane production for different feed additives, counts of studies, minimum and maximum of MD. Only studies conducted *in vivo* were included in the analysis.



# Identity of the project

METH'ALGUES, a collaborative research project

METH'ALGUES aims at evaluating the anti-methanogenic capacity of algae available on the French coasts with in vitro and in vivo trials.



#METHALGUES

Algae are there!

You are here!



# Screening, in vitro & in vivo

## A screening

for a better evaluation of the potential of the resources

7 seaweed species have been selected based on bromoform & polyphenol concentrations.

*Ulva sp. (ex Enteromorpha sp.)*



*Asparagopsis spp*



*Chondrus crispus*



*Enteromorpha spp*



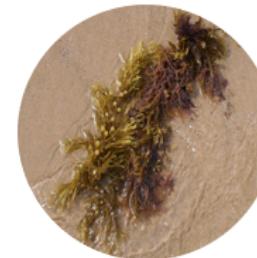
*Fucus vesiculosus*



*Ascophyllum nodosum*



*Sargassum muticum*



# Screening, in vitro & in vivo

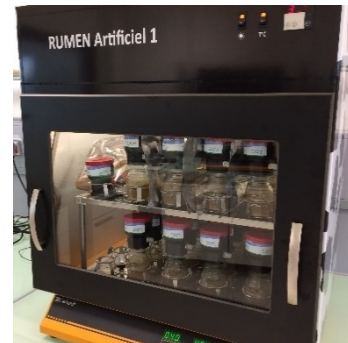
In vitro for evaluating the potential of methane mitigation

Artificial rumen with measures of CH<sub>4</sub> volume and concentration, VFA, NH<sub>3</sub>, pH, protozoaires, and digestibility (dry matter, NDF and ADF)

**Bromoforme:** -80% in CH<sub>4</sub> volume with 20 mg/day of active compound but negative effect in digestibility on proportion with dose-dependent negative effect on digestibility

**Polyphenols:** -45% to -98% of CH<sub>4</sub> volume depending on the dose but reduction of VFA concentration and DM digestibility

	<i>Asparagopsis armata</i>			<i>Enteromorpha (Ulva sp.)</i>	<i>Chondrus crispus</i>	<i>Fucus vesiculosus</i>	<i>Ascophyllum nodosum</i>	<i>Sargassum muticum</i>
	Extract	Dry	Fresh	Dry	Dry	Extract	Extract	Extract
Forme	Extract	Dry	Fresh	Dry	Dry	Extract	Extract	Extract
CHBr <sub>3</sub> dose	d2	d3	d5	d1	d1	-	-	-
Dose of polyphénol	-	-	-	-	-	60g/j	25g/j	3g/j
Gas volume	-13%	-8%	-7%	-2%	-20%	-91%	-25%	11%
CH <sub>4</sub> Concentration	-79%	-89%	-89%	-27%	-18%	-77%	-20%	26%
CH <sub>4</sub> Volume	-82%	-90%	-90%	-22%	-40%	-98%	-44%	39%
VFA Concentration	-16%	-21%	-25%	-4%	-4%	-40%	-18%	9%
DM digestibility	3%	-10%	-25%	-1%	-9%	-72%	-21%	-6%



# Screening, in vitro & in vivo

In vitro for evaluating the potential of methane mitigation



Reducing methane production while maintaining rumen activity at the same time

*Fucus vesiculosus* cuts almost all methane production BUT also decreases rumen activity.

*Chondrus crispus* cuts by 40% methane production AND does not reduce rumen activity.

Standard: *Asparagopsis armata* cuts methane production between 79% to 90% and reduces rumen activity by 16% to 25%.



# Screening, in vitro & in vivo

## In vivo in a **latin-square design**

20 dairy cows (4 groups of 5), mid-lactation, 40% of primiparous

4 periods of 3 weeks = Individual DM, milk production and enteric methane emissions in week 3

**Ad libitum diet** based on corn silage and concentrates (~13.5% of crude protein content)

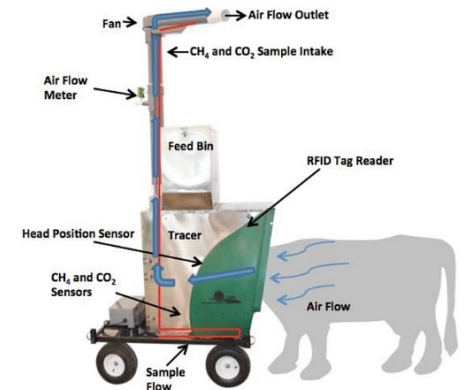
**Additives:** manually added and mixed to the diet

- **CONTROL** => no additive
- **ROULLIER** (with red algae) => 10 g/day in 1 distribution/day
- **CHONDRUS** => 100 g/day in 2 distributions/day
- **FUCUS** => 100 g/day in 2 distributions/day

*Chondrus crispus*



*Fucus vesiculosus*







# Screening, in vitro & in vivo

## In vivo in a latin-square design

No effect on DM Intake 25.6 kg/cow/d, rse = 0.8  
 No effect on Milk Yield 34.6 kg/cow/d, rse = 1.1

⇒ Good news, no appetency and digestibility problems

No effect on CH4 emissions 533 g/cow/d, rse = 93

Treatment	Enteric CH4 emissions	
	Mean (g CH4/cow/day)	stand error
CHONDRUS	525	9.2
FUCUS	535	9.0
ROULLIER	542	8.8
CONTROL	530	8.6

Microbiote adaptation on week 3?  
 => No kinetics observed.

Too low inclusion rate?  
 => 0.4% for *Chondrus* and *Fucus*, 0.04% for Roullier  
 => 20% lower than expected due to higher intake than expected

# Screening, in vitro & in vivo

## In vivo in farm conditions

2 groups of 25 dairy cows, with 30% of primiparous

12 weeks of trial

Mix of *Chondus* and *Fucus*, 1.5% of inclusion rate in the diet

Ad libitum diet based on corn silage and rapeseed meal

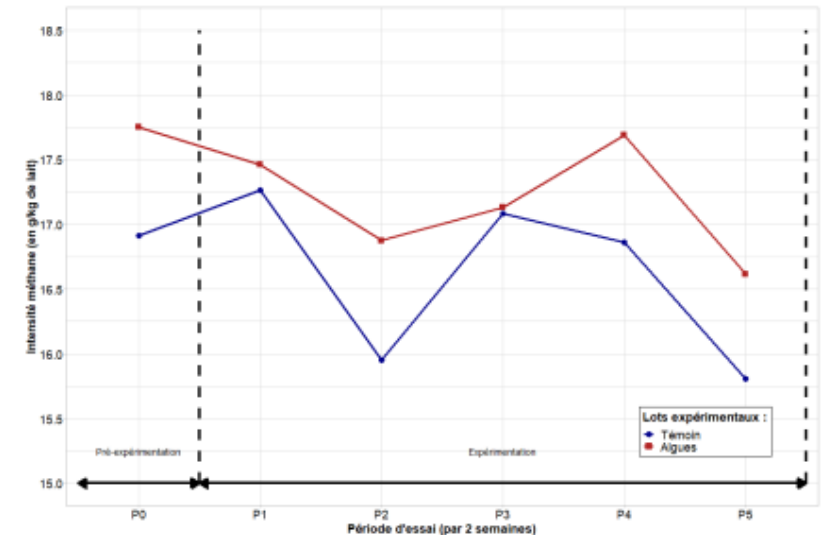
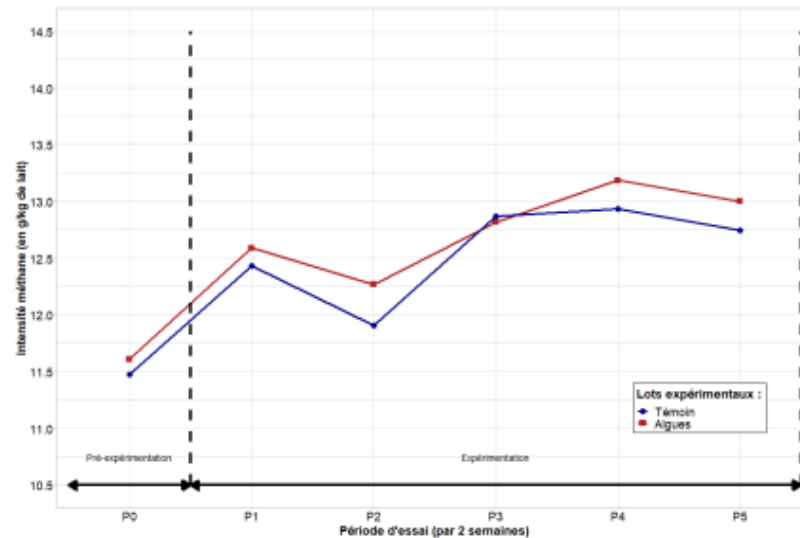
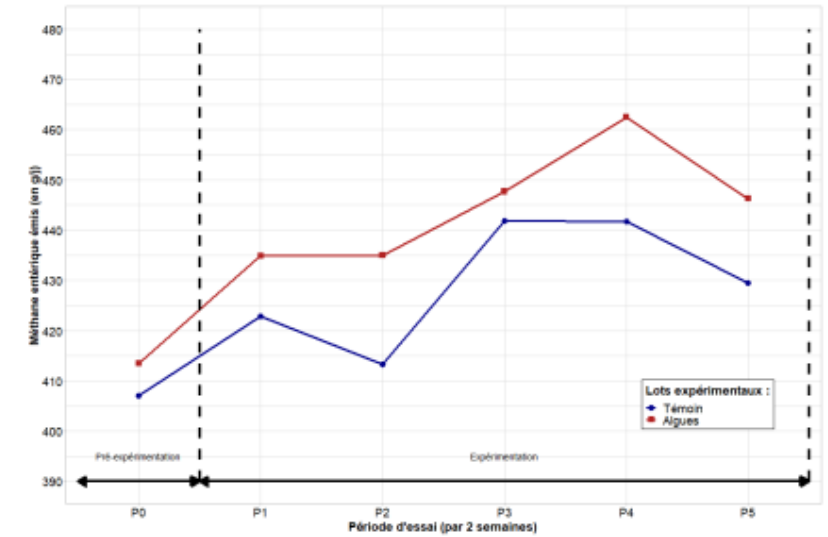
Individual feed intake, production performances and methane emissions



# Screening, in vitro & in vivo

## In vivo in farm conditions

Variables	Control (n=24)	Algae (n = 25)	p-value
DMI (kg DM/cow/day)	25.4	25.2	0,73
Milk (kg/cow/day)	33.4	33.8	0,28
Protein content (g/kg)	35.2	34.9	0,14
Fat content (g/kg)	44.8	43.9	0,16
CH <sub>4</sub> (g/cow/day)	426	438	0,17
CH <sub>4</sub> (g/kg of milk)	12.8	12.9	0,84
CH <sub>4</sub> (g/kg of DMI)	16.8	17.4	0,19





# Conclusion

No *in vivo* reduction of methane production has been obtained with *Fucus* and *Chondrus* in METH'ALGUES project.

## Questions to solve:

- Difficulties to switch from in vitro to in vivo experiments
- Is it a problem of the inclusion rate?
- Is there enough active compounds (bromoform, polyphenols) in these algae?
- Post analysis reveal that bromoform contents of both *Chondrus* and *Fucus* were very low, highlighting the important variability depending on location, season, etc.



Project certified by



Funding support

# Thank you for your attention

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*Asparagopsis* spp



*Chondrus crispus*



*Enteromorpha* spp



*Fucus vesiculosus*



*Ascophyllum nodosum*



*Sargassum muticum*

