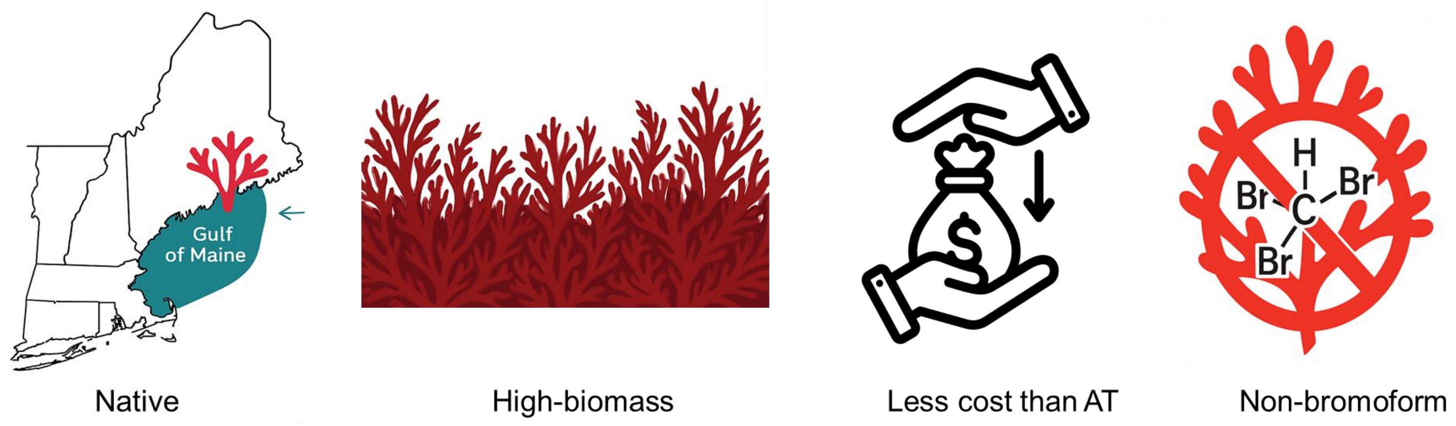
FEEDING CHONDRUS CRISPUS: EFFECTS ON ENTERIC METHANE EMISSIONS AND ENERGY UTILIZATION IN GRAZING DAIRY COWS

M. A. Rahman, W. M. Sims, M. L. Fischer, M. A. Arshad, M. M. H. Khandakar, M. G. M. Carvalho, L. C. R. Junior, O. Osuolale, K. V. Almeida and A. F. Brito

Department of Agriculture, Nutrition, and Food Systems, University of New Hampshire, Durham, NH 03824, USA

mdatikur.rahman@unh.edu

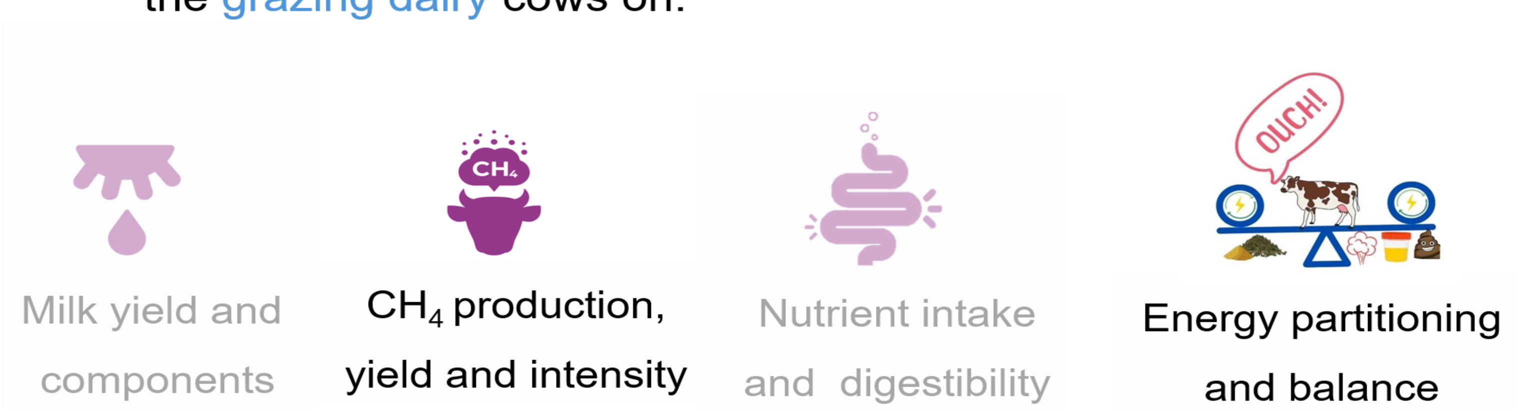
RATIONALE



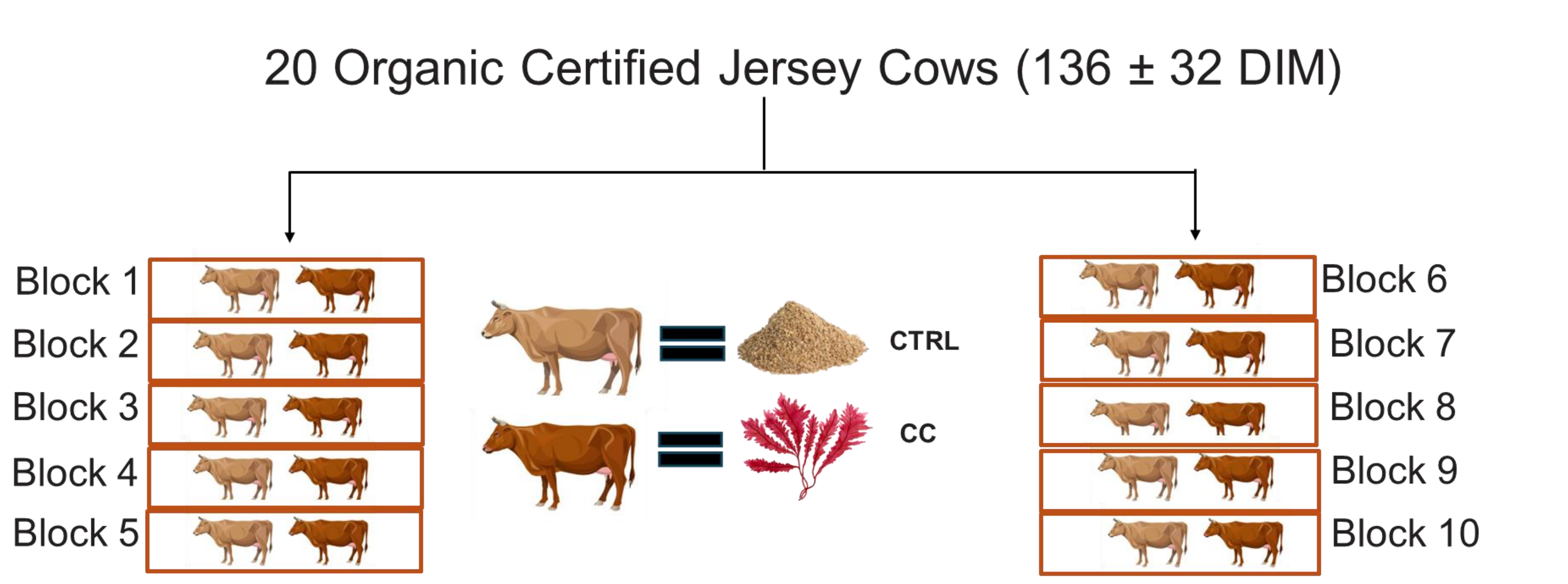
- *Asparagopsis taxiformis* (AT) has been the most effective seaweed in mitigating enteric methane emissions in diary cows due to the halogenated compound bromoform (Angelotti et al., 2025).
- However, limited studies have focused on non-bromoform containing red seaweed (e.g., *Chondrus crispus*; Reyes et al., 2025).
- *Chondrus crispus* (**CC**) is a high-biomass red seaweed native to the Gulf of Maine.
- Therefore, it is important to evaluate the potential of any locally grown red seaweed in production performances and enteric gas emissions in dairy cows.

OBJECTIVE

Our objectives were to evaluate the effects of feeding 3% [seaweed] to the grazing dairy cows on:



MATERIALS AND METHODS



CTRL = Control (No seaweed) **CC = 3% Red Seaweed (*Chondrus crispus*)**

- Cows had access to a grass-legume pasture mix (herbage allowance = 17.5 kg/cow daily) for 16 h/d and housed for 8 h/d when they received a partial TMR (pTMR) and were milked twice.
- Cows were randomly assigned to 1 of 2 diets: (1) pasture plus pTMR (control = CTRL) or (2) pasture, pTMR, and 3% C. crispus (seaweed = CC).
- Data were analyzed using mixed procedure of SAS

RESULTS

Table 1. Ingredients and nutrient composition of the diets fed to all experimental cows

Item	Diet (% of diet DM)	
	CTRL[1]	CC[2]
Pasture	33.5	33.5
Baleage	24.6	21.7
Mash - 1	41.0	0.00
Mash - 2	0.00	41.0
Habilac Fat	0.76	0.76
Seaweed (*Chondrus crispus*)	0.00	3.0
Ca iodate	0.12	0.00
Nutrient Composition		
DM, % of fresh matter	50.5	49.3
CP, % of DM	15.6	16.1
Ash, % of DM	11.0	10.8
ADF, % of DM	21.4	20.6
aNDFom, % of DM	35.4	34.7

[12]Cows fed no seaweed (CTRL) or 3% inclusion (DM basis) of *Chondrus Crispus* (CC).

Table 2. Energy utilization and efficiency in Jersey cows grazing pasture and a partial TMR (pTMR) plus 0% (control diet = CTRL) or 3% *Chondrus crispus* (Seaweed diet = CC) of diet DM

Item	Treatment (T)			*P-value*[1]		
	CTRL	CC	SEM	T	W[2]	T × W
Component, Mcal/d						
Fecal energy	27.4	29.6	0.82	0.01	0.06	0.53
Urinary energy	4.43	3.31	0.30	0.02	<0.01	0.17
CH_4 energy	5.27	4.78	0.10	<0.01	0.01	0.95
Heat production	27.6	28.1	0.56	0.40	<0.01	0.66
Milk energy	23.2	22.9	0.70	0.75	0.06	0.95
Tissue energy	17.7	25.3	1.80	<0.01	<0.01	0.01
Efficiency, %						
ME/DE	87.6	90.2	0.52	<0.01	0.06	0.03
Milk energy/ME	33.8	29.9	0.95	<0.01	0.08	0.07
Heat production/ME	40.4	36.9	0.98	<0.01	0.01	0.02
Tissue energy/ME	24.8	33.1	1.11	<0.01	0.07	0.09

[1]Significant difference between diets was declared at $P \leq 0.05$ and trends at $0.05 < P \leq 0.10$.
[2]Wk 4 (July 18 to July 25); Wk 8 (August 15 to August 22)

Table 3. Gaseous emissions and dietary energy intake in Jersey cows grazing pasture and a partial TMR (pTMR) plus 0% (control diet = CTRL) or 3% *Chondrus crispus* (Seaweed diet = CC) of diet DM

Item	Treatment (T)			*P-value*[1]		
	CTRL	CC	SEM	T	W[2]	T × W
O_2 consumption, kg/d	8.14	8.31	0.17	0.37	0.10	0.94
CO_2 production, kg/d	10.1	10.1	0.18	0.66	<0.01	0.32
H_2 production, g/d	1.02	1.10	0.07	0.43	<0.01	0.63
CH_4 production, g/d	400	362	7.49	<0.01	<0.01	0.94
CH_4 yield, g/kg of DMI	17.8	15.1	0.46	<0.01	0.09	0.77
CH_4 intensity, g/kg of ECM	11.9	11.1	0.43	0.02	0.02	0.51
Fractions, Mcal/d						
Gross energy intake	106	114	2.48	<0.01	<0.01	0.01
Digestible energy (DE) intake	77.6	84.5	2.02	<0.01	<0.01	0.01
ME intake	68.2	76.0	2.16	<0.01	<0.01	0.01
NE_L intake	45.7	50.6	1.37	<0.01	<0.01	0.01

[1]Significant difference between diets was declared at $P \leq 0.05$ and trends at $0.05 < P \leq 0.10$.
[2]Wk 4 (July 18 to July 25); Wk 8 (August 15 to August 22)

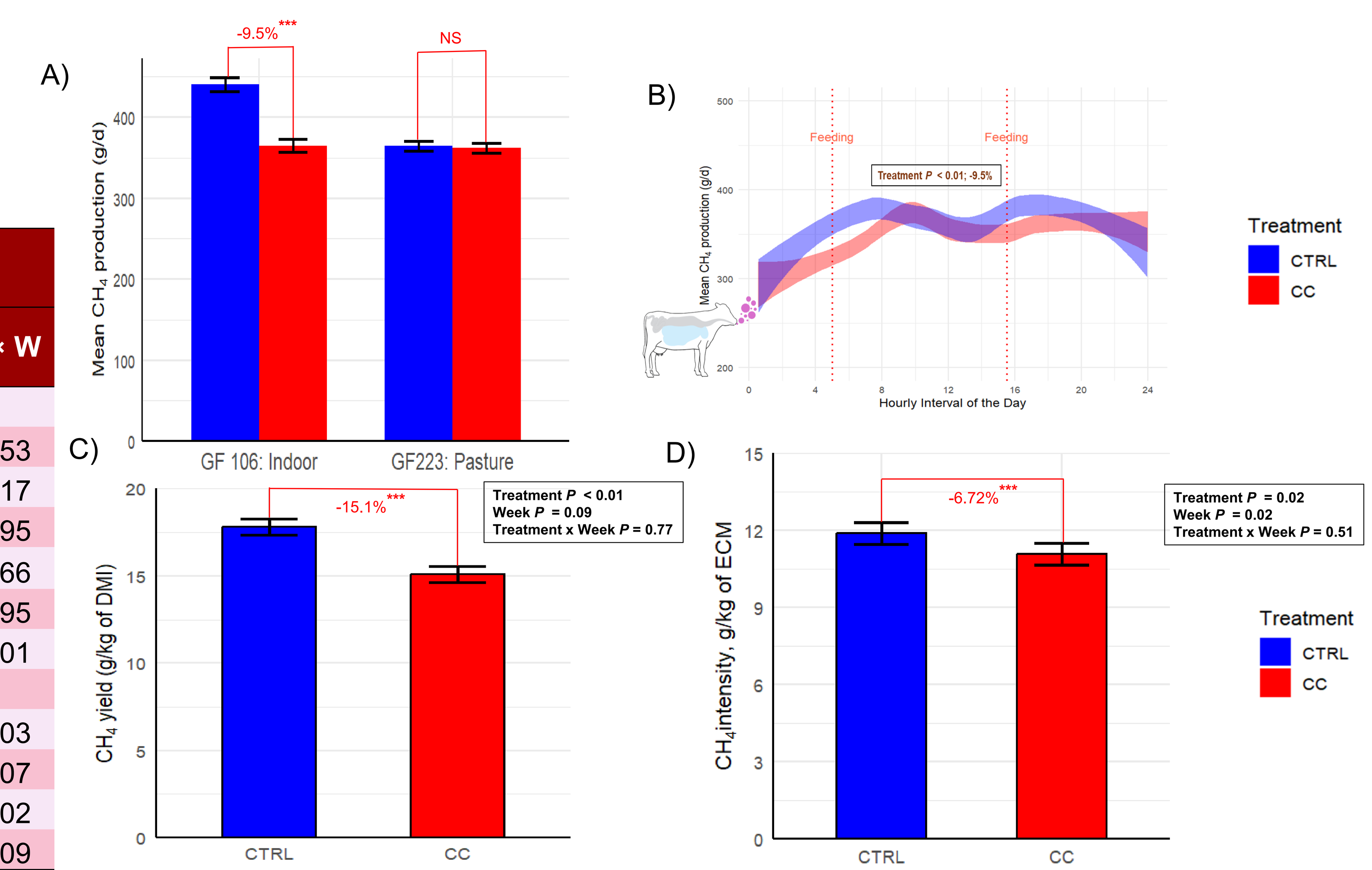


Fig 1. A) Mean CH_4 production in indoor and pasture (GF x T, $P < 0.01$), B) diurnal CH_4 production, C) CH_4 yield, and D) CH_4 intensity in Jersey cows grazing pasture and a partial TMR (pTMR) plus 0% (control diet = CTRL) or 3% *Chondrus crispus* (Seaweed diet = CC)

CONCLUSIONS

- Enteric CH_4 production, CH_4 yield, and CH_4 intensity decreased 9.5%, 15.1% and 6.72% respectively with feeding CC compared to CTRL.
- Cows fed CC had greater intake of gross energy, digestible energy, ME, and NE_L than those fed CON.
- The efficiency (%) of converting digestible energy to ME, and ME to tissue energy was greater in CC than CON cows. Contrarily, the efficiency of converting ME to milk energy decreased in CC versus CON. Overall, cows fed CC showed reduced enteric CH_4 emissions, but they were less efficient to convert ME into milk energy.

REFERENCES

- Angellotti, M., M. Lindberg, M. Ramin, S.J. Krizsan, and R. Danielsson. 2025. Asparagopsis taxiformis supplementation to mitigate enteric methane emissions in dairy cows—Effects on performance and metabolism. J. Dairy Sci. 108:2503–2516. doi:10.3168/jds.2024-25258.
- Reyes, D.C., J.P. Sacramento, C.T.C. Quigley, B. Twining, A.B. Michaud, D. Emerson, B. Honisch, O. Keleher, M.A. Rahman, N.N. Price, and A.F. Brito. 2025. Feeding incremental amounts of the red seaweed Chondrus crispus: Effects on production performance, methane emissions, nutrient utilization, and ruminal and iodine metabolism in dairy cows. Journal of Dairy Science. doi:10.3168/jds.2024-26244.

ACKNOWLEDGEMENTS

- USDA National Institute of Food and Agriculture OREI award # 2021-51300-35226.
- Partial funding was provided by the New Hampshire Agricultural Experiment Station (Durham, NH)
- This project was further supported by the USDA Hatch Multistate NC-2042 (Project Number NH00616-R; Project Accession Number 1001855).
- Special thanks to the University of New Hampshire Burley-Demeritt Organic Dairy Research Farm staff for animal care and overall research support.