

# Effects of linseed oil, brown seaweed and seaweed extract on animal production and methane emissions in beef cattle

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# Introduction

- Globally: Livestock production – 14.5% GHG
  - CH<sub>4</sub> - 44% of GHG from livestock production
- Ireland: Agriculture - 37% GHG
  - Methane accounts for ~70% of Irish agri-GHG emissions (EPA, 2022)
- Legally binding commitments
  - EU Green Deal: 55% ↓ in GHG by 2030
- Teagasc Climate Action Strategy 2022-2030
  - Breeding
  - Feed additives
    - Rigorous regulatory process – EFSA
    - Natural feed additives advantageous



# Lipids

- Plant oils enriched in PUFA ↓ CH<sub>4</sub>
- Mode of action:
  - Inhibition of methanogens and protozoa
  - Alteration of VFA profiles
  - Reduction in feed fermented
  - Biohydrogenation of FA – Sequestering H<sub>2</sub>
- Reduction in DMI at inclusion >5%
- 1% ↑ fat = 3.77% ↓ CH<sub>4</sub> g/d
  - 3.3% RSO ↓ CH<sub>4</sub> 19% (Brask et al., 2013)
  - 6% SO ↓ CH<sub>4</sub> 39% (Jordan et al., 2006)
  - 3.4% LO ↓ CH<sub>4</sub> 16% (Boland et al., 2020)



# Seaweeds



## ■ Red seaweeds

- *A. taxiformis*: ↓ CH<sub>4</sub> by >80% *in vitro* (Kinley *et al.*, 2016), in sheep (Li *et al.*, 2016), beef (Roque *et al.*, 2021)
- *A. armata*: ↓ CH<sub>4</sub> by 50% in dairy cows (Roque *et al.*, 2019)
- Quantification of bioactive (bromoform) is critical
  - » 36 and 68% ↓ in CH<sub>4</sub> mmol/d observed with 2 different samples (Roskam *et al.*, 2022)
  - » Dairy study with 4 periods: period 1 + 2 - 65% ↓ in CH<sub>4</sub>; period 3 + 4 no reduction (Stefenoni *et al.*, 2021)

## ■ Brown seaweeds

- Indigenous, plentiful, inexpensive
- Main bioactive – phlorotannin
- Mineral and protein content
- Inconsistent anti-methanogenic results





# Objectives

- Assess the effects of natural feed additives supplemented twice daily on:
  - Dry matter intake
  - Animal performance
  - Gaseous emissions

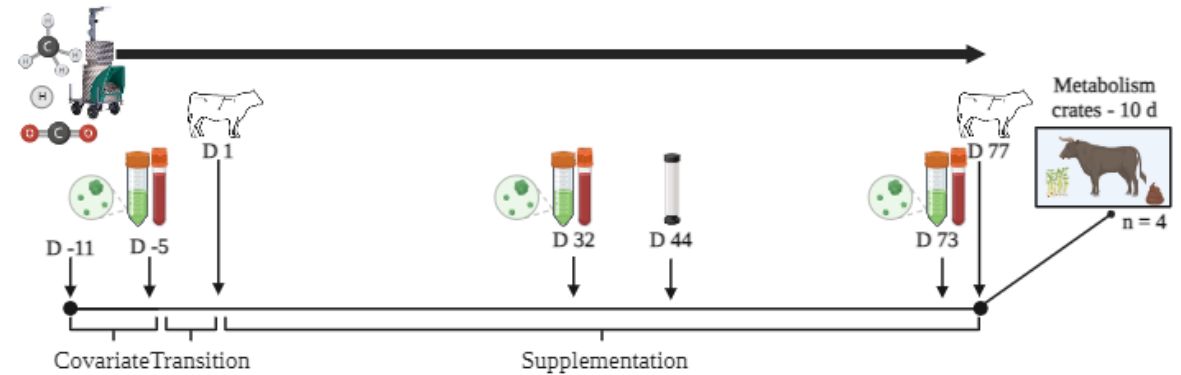
# Materials and Methods

- 72 dairy X bulls
  - ~12 months old/380kg
- RCB – BW, breed, baseline CH<sub>4</sub>
- 4 dietary treatments (n=18)
  - Control (No supplementation)
  - Linseed oil (4%) (12.8% of ration)
  - Seaweed (2%) (6.4% of ration)
  - Extract (2%) (6.4% of ration)

## ■ Diet

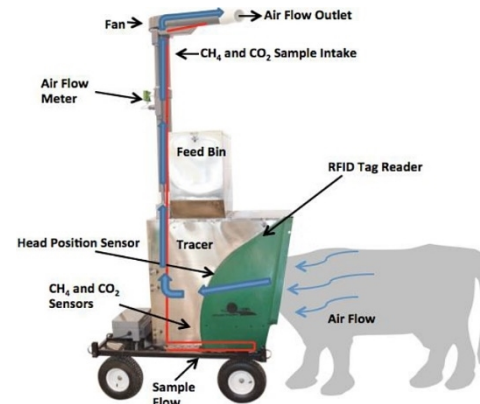
- 60:40 forage:concentrate
- Concentrates: Barley based with additive included
  - **Fed 2x/d (AM + PM)**
- ~1kg bait feed from GreenFeed

Figure 1



Experimental timeline, indicating timepoints for gaseous emissions measuring, rumen and blood sampling, muscle and backfat scanning and digestibility study

Created in BioRender.com



# Effects of offering beef bulls linseed oil, seaweed or a seaweed extract on intake and animal performance

Item	Treatment				SEM	P-value
	CON	LSO	SW	EX		
DMI, kg/d	7.14	6.84	7.30	6.92	7.050	0.064
Start weight, kg	380	380	377	377	4.6	0.9254
Mid weight, kg	426	423	426	418	5.4	0.6726
End weight, kg	463	459	463	447	6.1	0.1916
ADG, kg/d	1.09 <sup>a</sup>	0.96 <sup>ab</sup>	1.06 <sup>ab</sup>	0.92 <sup>b</sup>	0.045	0.0326
FCR <sup>1</sup>	6.66	7.30	7.07	7.95	0.353	0.0949

<sup>a,b</sup> Means within a row with different superscripts differ significantly ( $P < 0.05$ )

# Effects of offering beef bulls linseed oil, seaweed or a seaweed extract on enteric gaseous emissions

Item	Treatment				SEM	P-value
	CON	LSO	SW	EX		
CH <sub>4</sub> ; g/d	208.1 <sup>a</sup>	171.2 <sup>c</sup>	201.1 <sup>ab</sup>	194.4 <sup>b</sup>	3.34	<.0001
CH <sub>4</sub> ; g/kg DMI	29.87 <sup>a</sup>	24.93 <sup>b</sup>	28.22 <sup>a</sup>	27.96 <sup>a</sup>	0.573	<.0001
CH <sub>4</sub> ; g/kg BW	0.498 <sup>a</sup>	0.400 <sup>c</sup>	0.481 <sup>ab</sup>	0.464 <sup>b</sup>	0.0091	<.0001
CH <sub>4</sub> ; g/kg ADG	196.8 <sup>ab</sup>	179.2 <sup>b</sup>	197.3 <sup>ab</sup>	219.2 <sup>a</sup>	9.24	0.0236
H <sub>2</sub> ; g/d	0.535 <sup>a</sup>	0.424 <sup>b</sup>	0.539 <sup>a</sup>	0.500 <sup>ab</sup>	0.024	0.0037
CO <sub>2</sub> ; g/d	6892.8 <sup>ab</sup>	6470.0 <sup>b</sup>	6911.2 <sup>a</sup>	6892.8 <sup>ab</sup>	119.37	0.0289

<sup>a,b,c</sup> Means within a row with different superscripts differ significantly ( $P < 0.05$ )



# Conclusions

- Linseed oil
  - Sustainable
  - Natural
  - ↓ CH<sub>4</sub> and H<sub>2</sub> g/d by 18 and 20%
- Seaweed extract
  - Readily available
  - Inexpensive
  - ↓ CH<sub>4</sub> g/d by 7%
- Combinations?
- Limitations
  - Pellet quality
  - Effects on DMI/digestibility



# Acknowledgments



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