The dietary effects of a brown seaweed and its extract on dairy cow performance and methane emissions

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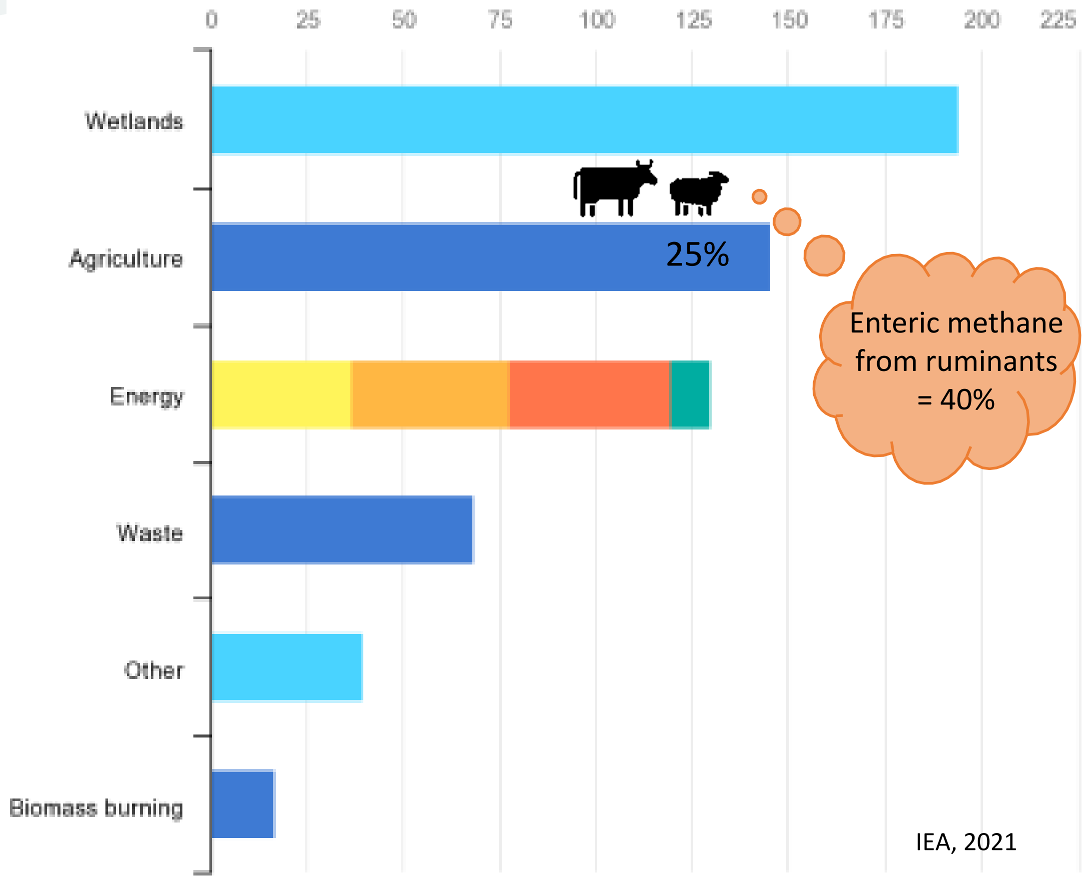
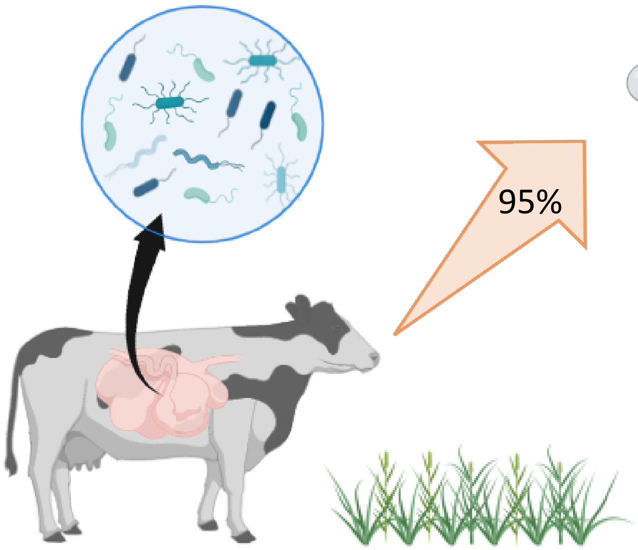
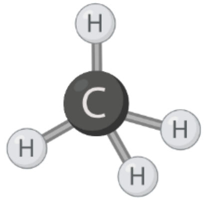
Enteric methane emissions

Sources of methane emissions







1. Plant material consumed
2. Bacterial fermentation
3. $H_2 + CO_2$
4. Methanogens
5. CH_4 out

Mitigation strategies:

1. Direct effect on methanogenic archaea community.
2. Indirect effect caused by the impact of a strategy on substrate availability (H_2) for methanogenesis.

Northern Ireland:

- 46% reduction in methane by 2050 from 1990 levels
- Ruminant production systems are a key focus area

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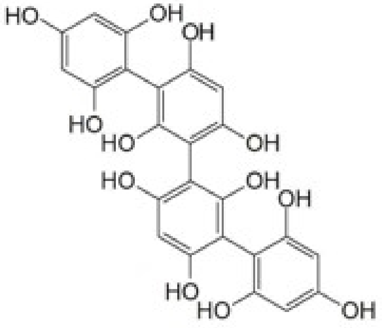
Seaweed and its role in CH_4 mitigation



Bioactive compound	Activity
Polysaccharides	Anti-thrombotic, anti-coagulant, anti-cancer, anti-proliferative, anti-viral, and anti-complementary agent, anti-inflammatory, prebiotics
Peptides and Amino Acids	Anti-inflammatory, anti-bacterial, anti-tumoral, antinociceptive; etc anti-oxidative, anti-inflammatory, anti-tumor, hepatoprotective and neuroprotective
Polyphenols and Phlorotannins	Antioxidants, anti-methanogenic
Pigments	Colour or pigment enhancement
Fatty Acids	Resilience to stress, alter Omega 6/3 ratio
Halogenated compounds	Antibacterial, anti-tumoral, anti-methanogenic

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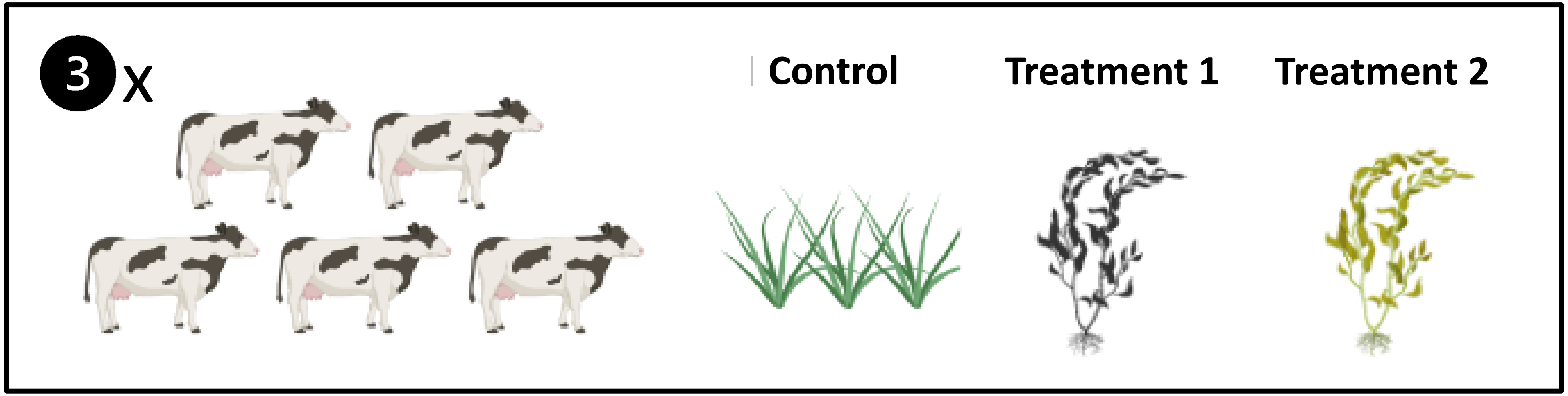
Key study aims

- Assess the effects of a selected brown seaweed and its extract on dairy cow performance and methane emissions
- Evaluate any differences between seaweed and seaweed extract provision
- Analysis of rumen fluid samples for changes in the microbiome, VFA and NH_3 production across dietary treatments

AFBI dairy cow study (3x3 Latin square)



- Feeding period = 21 days
- TMR diets with 60% grass silage and 40% concentrate (DM basis)
    - **Control:** Grass silage + concentrate
    - **Treatment 1:** grass silage + concentrate + 4% dried brown seaweed extract
    - **Treatment 2:** grass silage + concentrate + 4% dried brown seaweed
- Iodine level within legal limits for dairy production.

Measurements

- During the first 15 days of each period, cows were housed as a single group and gaseous exchange (CH_4, CO_2, O_2 and H_2) rates were measured using the Greenfeed system
- Feed intakes recorded using Biocontrol Auto-feeders (3/treatment)
- Liveweight and milk yield collected daily
- Milk composition and TMR samples collected weekly
- Collection of rumen fluid and blood samples on day 21

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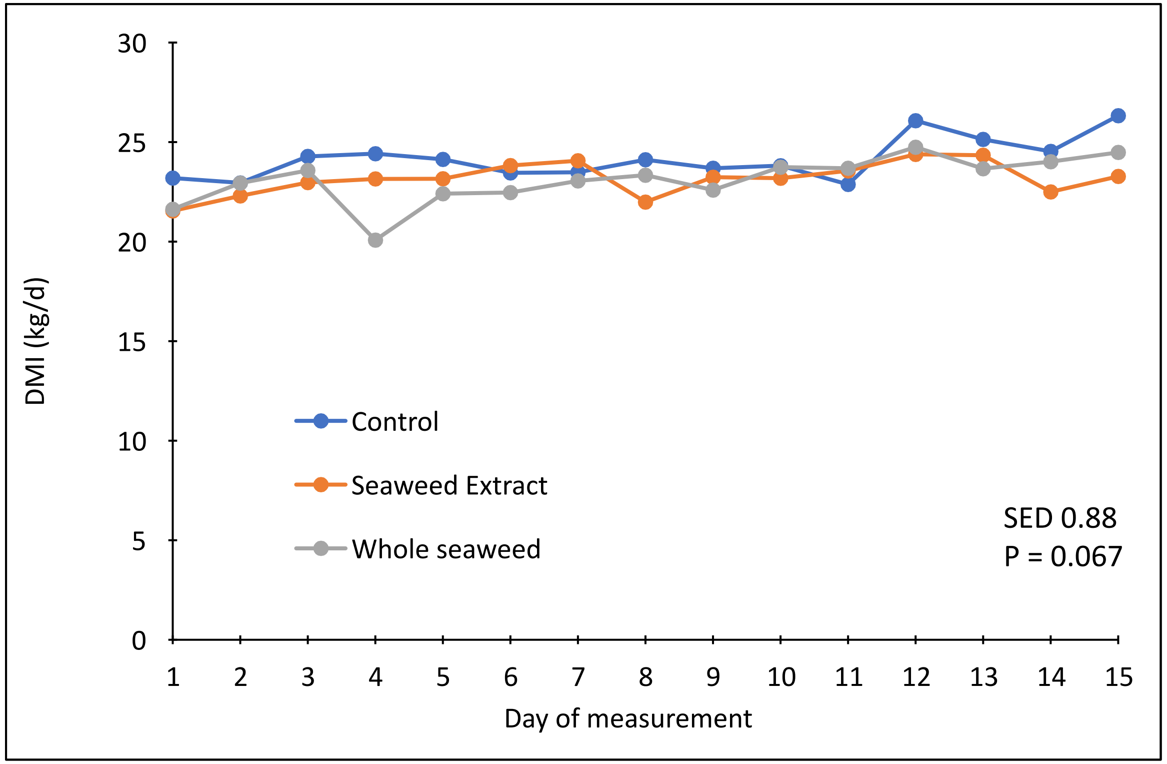
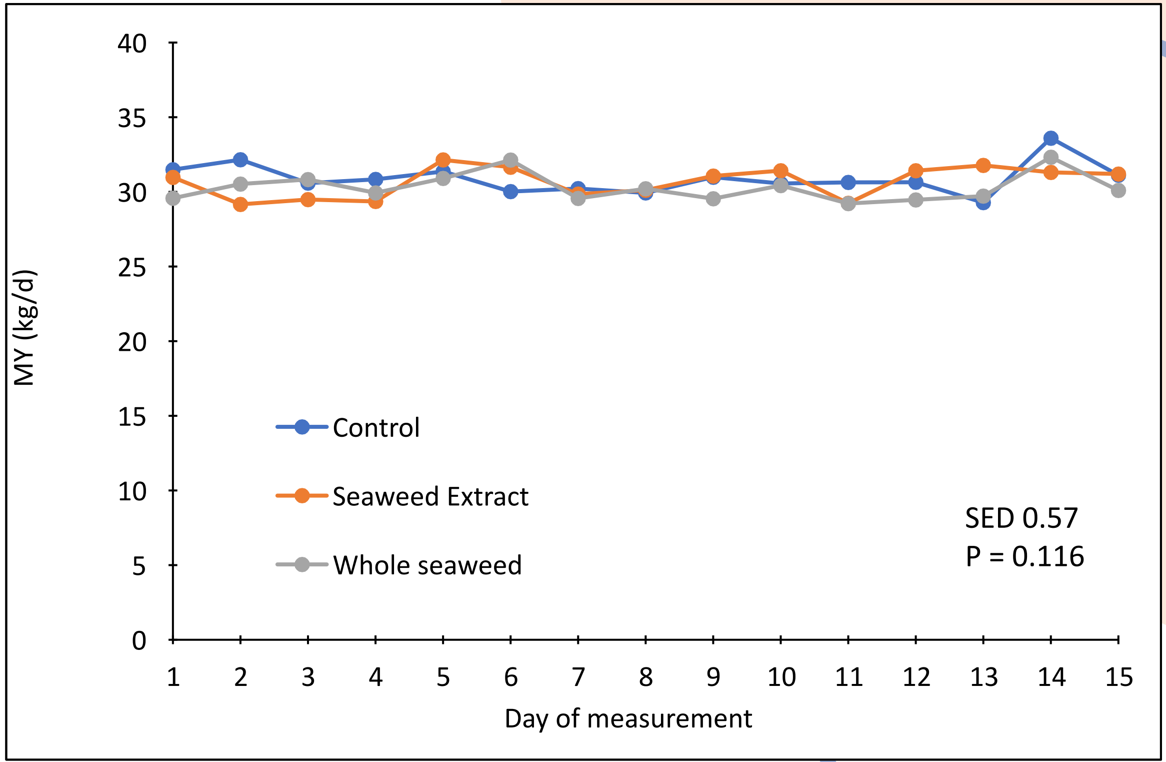
Average DMI and Milk Yield

Item	Treatment			SED	P-value
	Control	Whole seaweed	Seaweed Extract		
Animal measurement					
DM intake (kg/d)	24.6	23.8	23.5	0.88	0.067
Milk yield (kg/d)	31.1	30.1	31.2	0.57	0.116

DMI intake and MY production (kg/d)





Daily changes in MY and DMI

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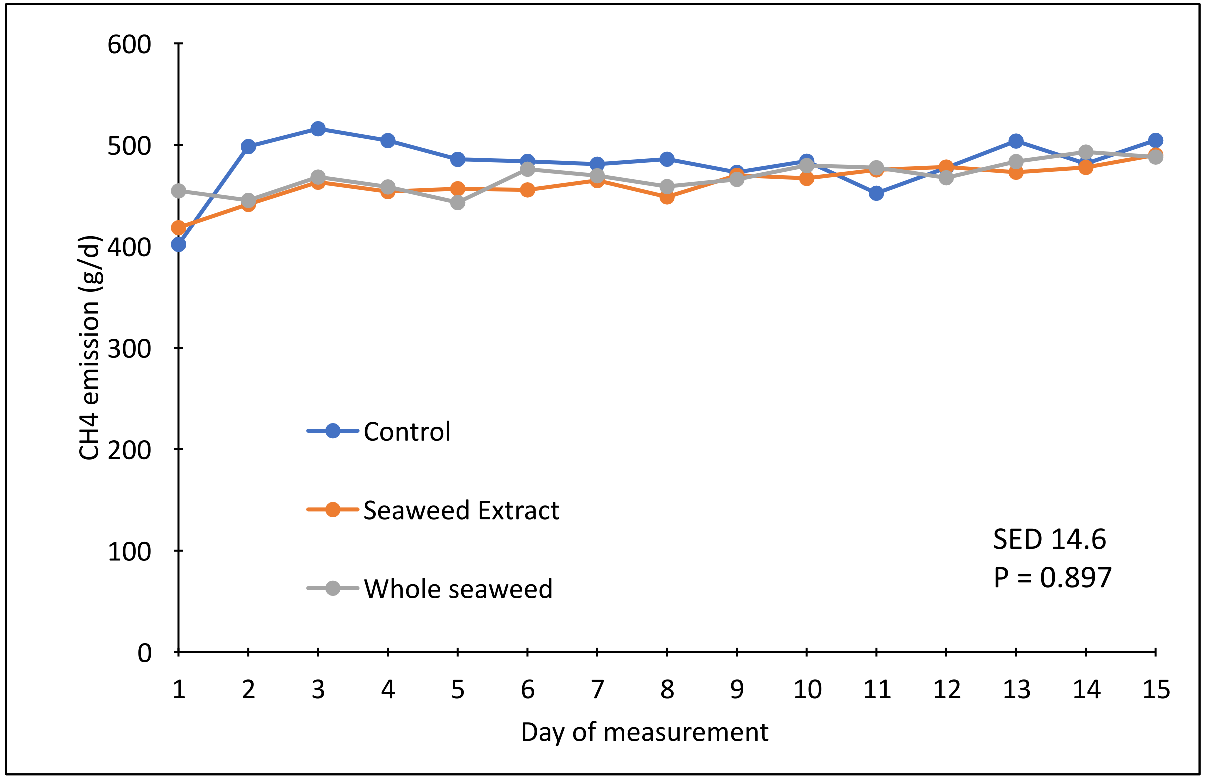
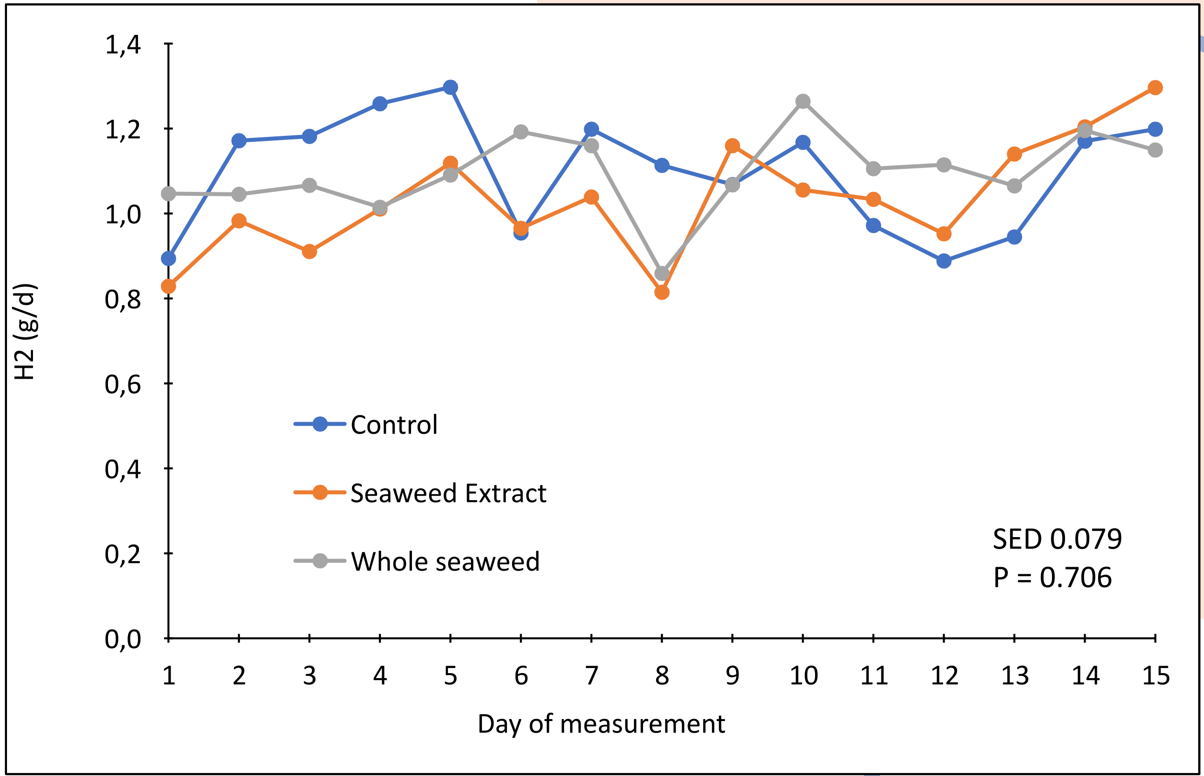
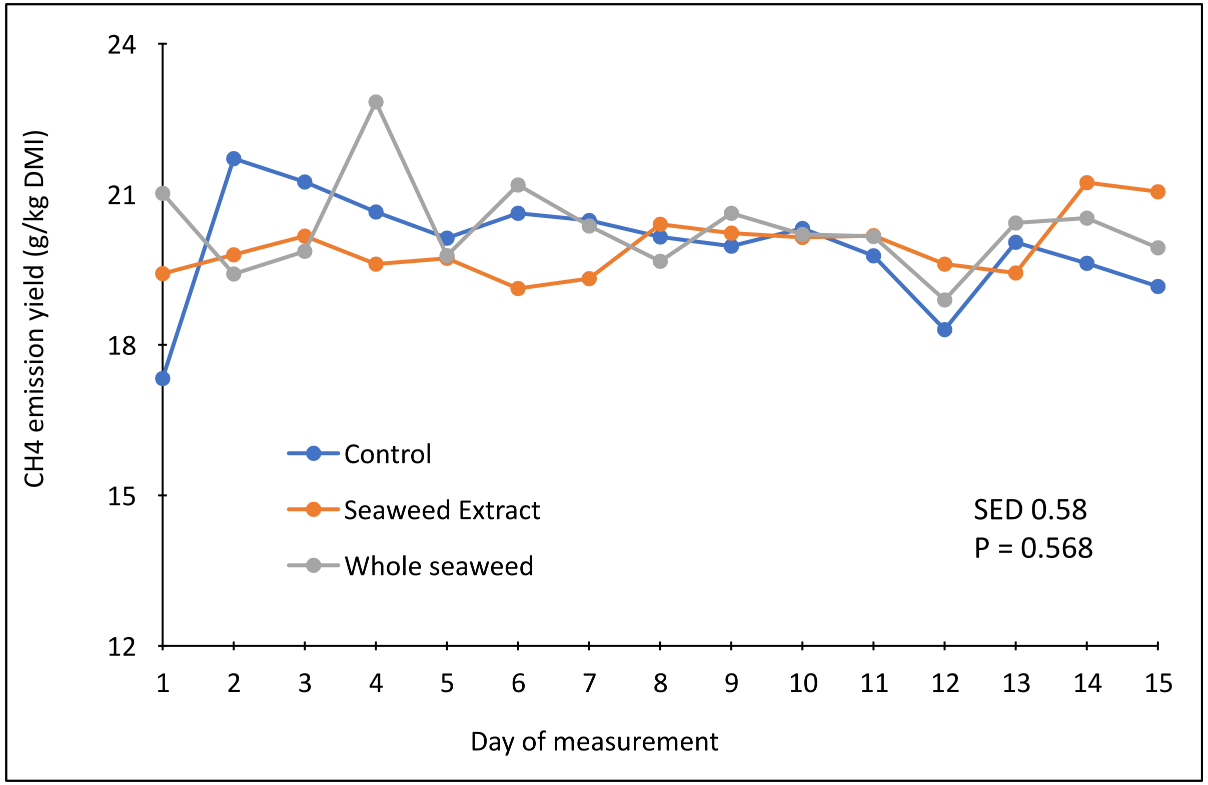
Methane and H_2 emissions (g/d)

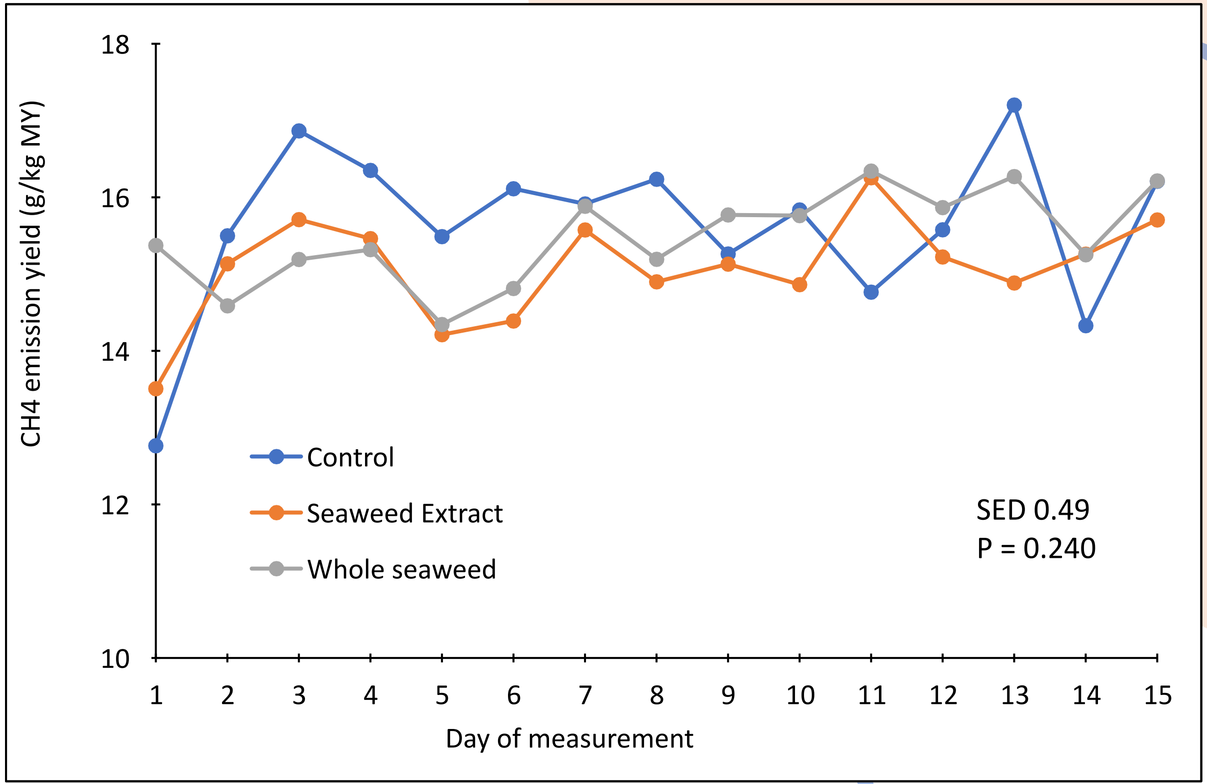




Daily changes of methane and hydrogen exchange rates

Methane emissions yield





Daily changes of methane emission yield

Results by feeding period

Item		Treatment			SED	P-value
		Control	Whole seaweed	Seaweed Extract		
Animal measurement						
DM intake (kg/d)	P1	25.1	24.0	23.2	1.55	0.471
	P2	24.9	24.5	23.5	1.73	0.724
	P3	23.9	23.0	23.8	1.68	0.863
Milk yield (kg/d)	P1	33.0	30.8	29.1	2.11	0.222
	P2	32.1	30	32.4	2.74	0.627
	P3	28.2	29.6	32.0	2.79	0.409
Gaseous exchange						
CH_4 emissions						
g/d	P1	489.8	461.8	464.6	31.24	0.625
	P2	478.6	518.6	473.6	35.46	0.407
	P3	478.5	462.9	489.5	36.56	0.770
g/kg DMI	P1	19.6	19.2	20.2	1.10	0.697
	P2	19.2	21.4	20.1	1.45	0.334
	P3	20.3	20.1	20.5	1.35	0.957
g/kg MY	P1	15.0	15.1	16.1	1.24	0.640
	P2	15.0	17.8	14.8	1.71	0.190
	P3	17.5	15.9	15.3	1.72	0.453
H_2 (g/d)	P1	1.05	0.91	0.81	0.139	0.255
	P2	1.09	1.28	1.35	0.198	0.428
	P3	1.01	1.15	1.11	0.177	0.710

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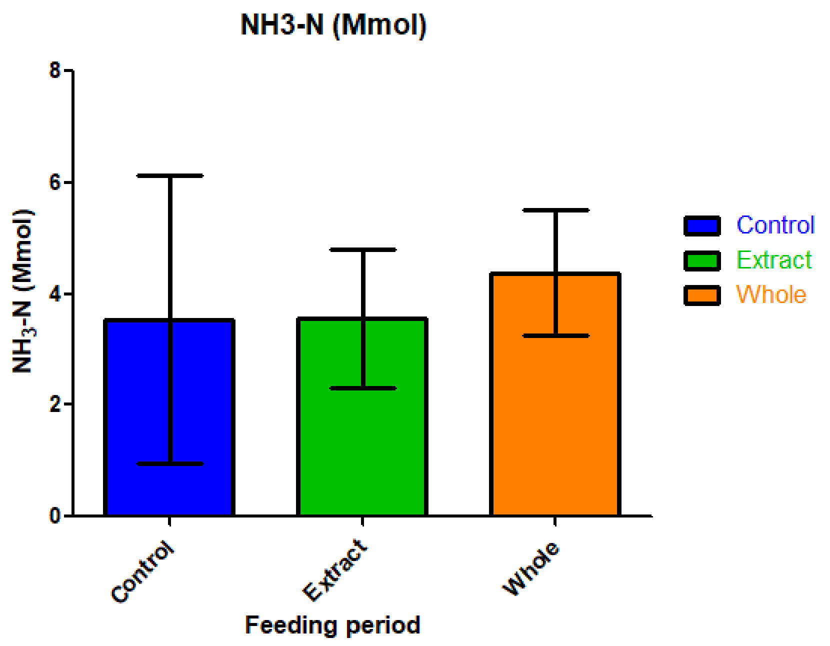
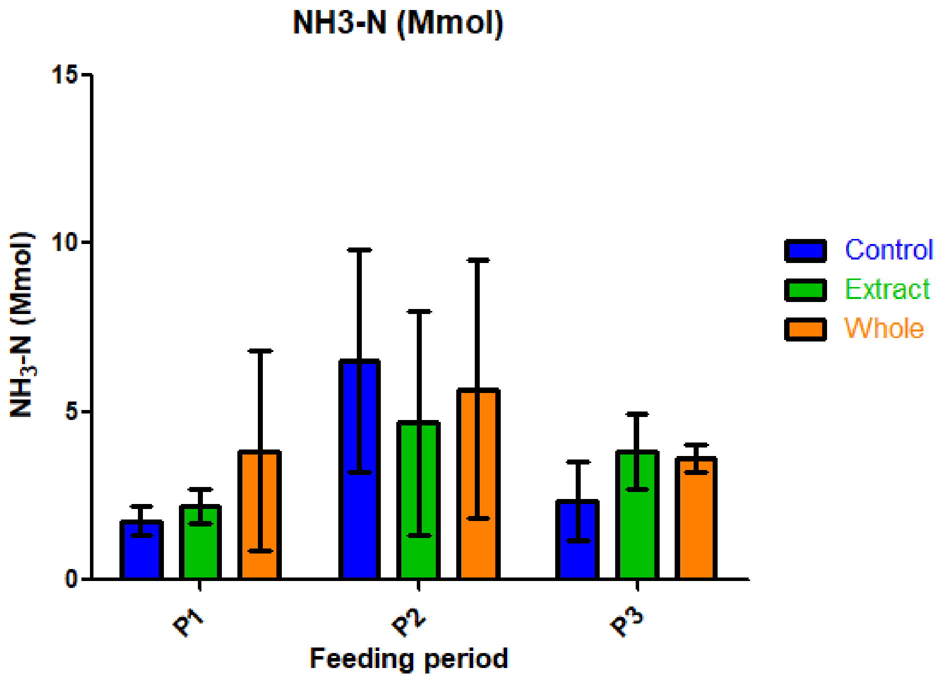
Ammonia (NH_3-N) concentration

No statistically significant differences across treatments within and across feeding periods. Variation as a result from feeding period (P<0.01).



One-way ANOVA with Bonferroni post-hoc test comparing treatments to control



Two-way ANOVA with Bonferroni post-hoc test comparing treatments to control

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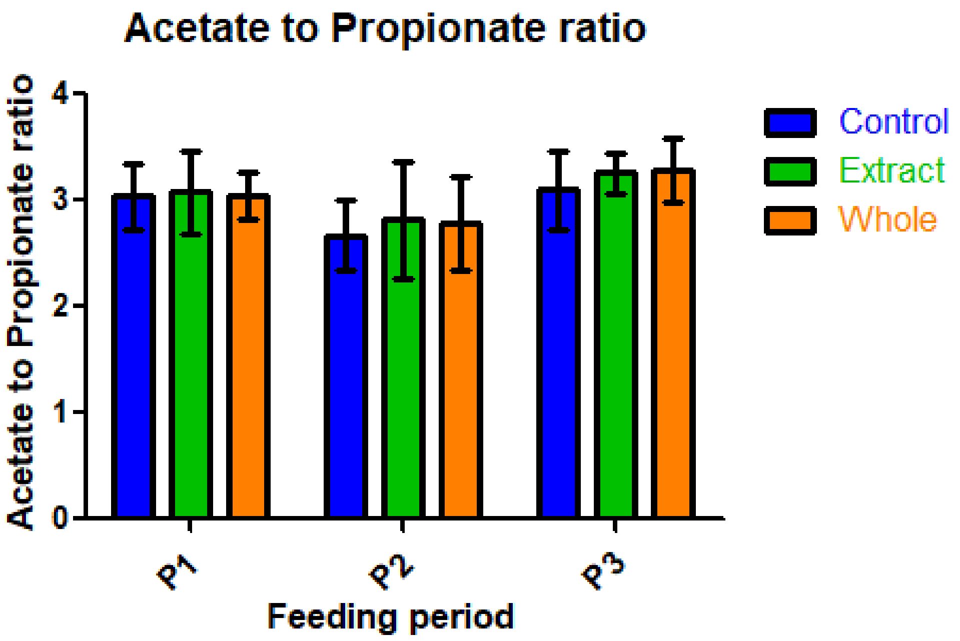
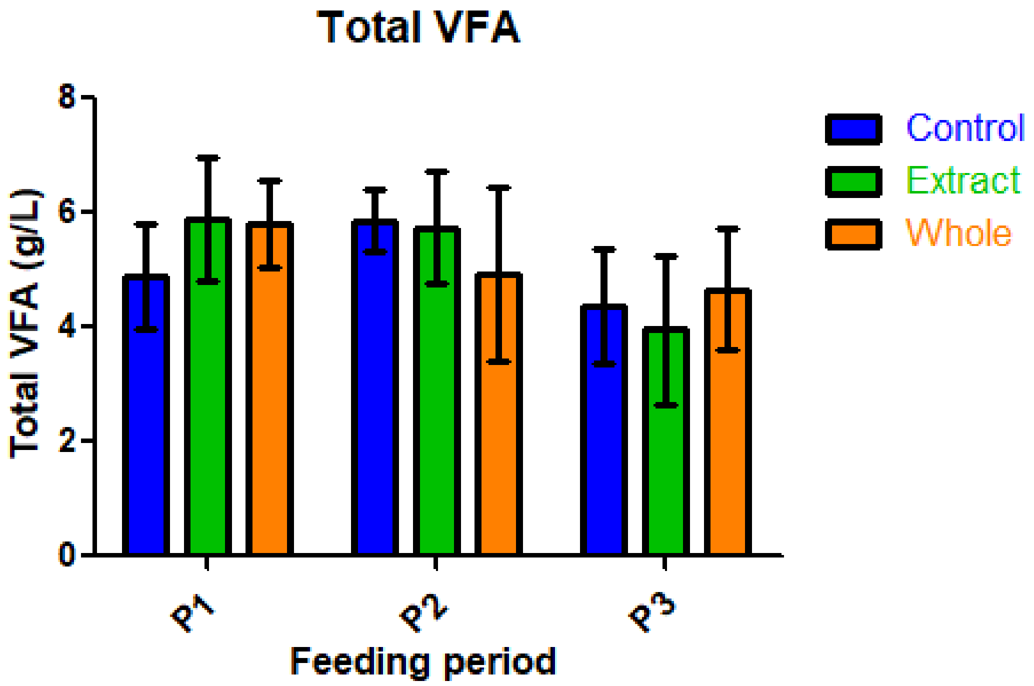
Volatile fatty acid results

- No statistically significant differences across treatments or feeding periods





Two-way ANOVA with Bonferroni post-hoc test comparing treatments to control

Conclusions

From preliminary analysis:

- Dietary inclusion (4% on DM basis) of seaweed or seaweed extract had no negative effects on DMI and MY
- No significant effect on methane emissions
- No significant effect on VFA or NH_3-N

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Future work

- Digestibility analysis to assess the effect of each treatment and compare to methane production
- Phlorotannin quantification of seaweed and extract to aid explanation for results attained
- Assess the nutrient profile of the milk for any potential benefits for human consumption
- Continuation of *in-vitro* screening across seaweed species
- Evaluation of other seaweed species *in-vivo*

Thank you for your attention

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