MICROALGAL USE AS INGREDIENTS FOR POTENTIAL METHANE ABATEMENT AND HEALTH BENEFITS IN COWS AND DOGS

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Introduction

Agriculture is the largest anthropogenic source of methane (CH_4) and is responsible for the release of approximately 145 Tg CH_4 y^{-1} to the atmosphere per annum. However, dairy and beef production also continues to helps feed the growing global population. Solutions in the form of feed additives offer potential to help reduce CH_4 production from cattle, cows and sheep. In this study, the anti-methane (CH_4) effect of the microalga *Chlorella* sp. (H-C-2-V-PF-T) was determined using *in vitro* methods for measuring CH_4, ammonia (NH_4) and total gas emissions. Microalga also have potential for use as protein and functional food ingredients to replace those generated from dairy and beef. A study to determine the heart health benefits of two microalgal species – *Chlorella* sp. (H-C-2-V-DF- F-2-T – defatted samples) and *Nannochloropsis* sp. (E1-A-4-V-P-1-TM-N-4-V-DF-T) produced on side-streams and supplied by VITO to Teagasc was carried out using specially designed *in vitro* and animal feed trials.

Methods

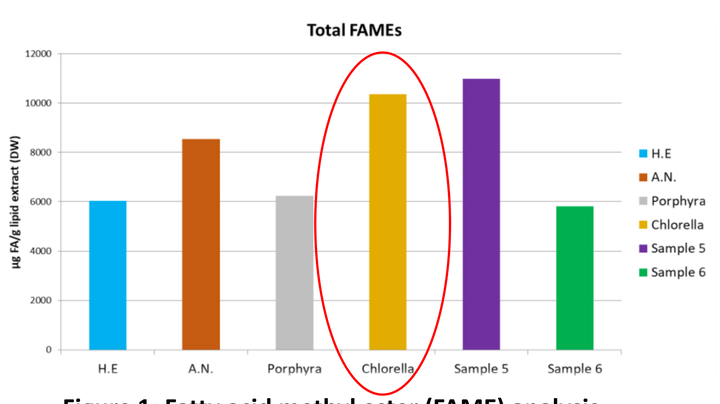


Figure 1: Fatty acid methyl ester (FAME) analysis

Microalgae	Protein (%w/w)	Fat (%w/w)	Moisture (%w/w)	Ash (%w/w)
Nannochloropsis (E1-A-4-V-P-1-TM-N-2-V-DF-T)	44.93 ± 0.23	2.23 ± 0.45	4.05 ± 0.06	6.69 ± 0.36
Defatted *Nannochloropsis* (E1-A-4-V-P-1-TM-N-2-V-DF-F-6-T)	52.44 ± 0.41	0.21 ± 0.04	5.81 ± 0.09	7.71 ± 0.01
Chloromonas (E1-A-5-V-P-1-TM-CH-1-V-DF-T)	39.00 ± 0.23	10.85 ± 2.72	5.45 ± 0.75	5.73 ± 0.46
Chlorella sp. (H-C-2-V-DF-T)	48.25 ± 0.16	0.90 ± 0.40	5.06 ± 0.15	10.31 ± 0.09
Mix algae (E1-A-5-V-mix1-DF-T)	23.08 ± 0.07	0.27 ± 0.12	4.08 ± 0.11	40.35 ± 0.11

Figure 2: Proximate compositional analysis (AOAC methods)

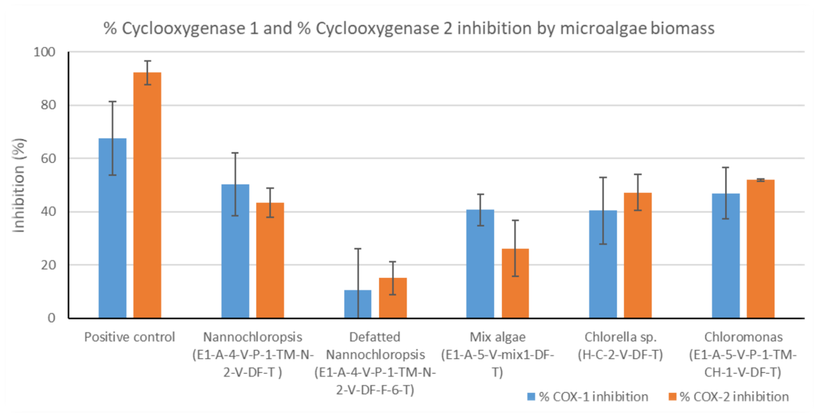


Figure 3: Cyclooxygenase (COX-1 and COX-2) inhibition assays

Chlorella sp (H-C-2-V-DF-T)	
* Aerobic Plate Count 30°C SOP 1.1168	> 3000000 cfu/g
* Coagulase positive staphylococcus SOP 1.1166	< 10 cfu/g
* Coliforms 35°C SOP 1.1146	< 10 cfu/g
* Escherichia coli SOP 1.1146	< 10 cfu/g
* Listeria Species SOP 1.1183	Not Detected /25 g
* Presumptive Bacillus cereus SOP 1.1097	< 10 cfu/g
* Salmonella SOP 1.1123	Not Detected /25 g

Figure 4: Total microbial load analysis (safety testing)

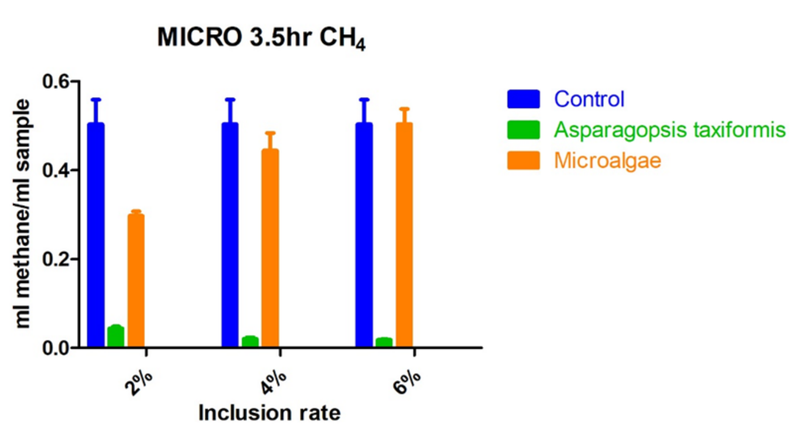
Figure 5: CH_4, NH_4 and total gas measurements

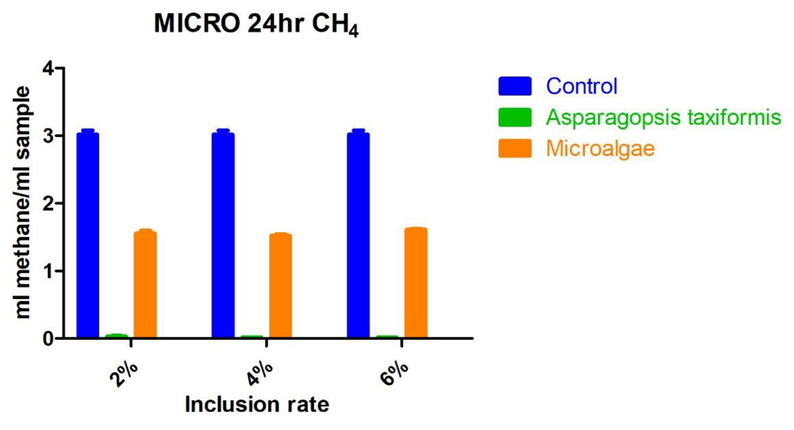
Figure 6: FEDIAF designed feed trial in elderly dogs To determine anti-hypertensive effect and palatability

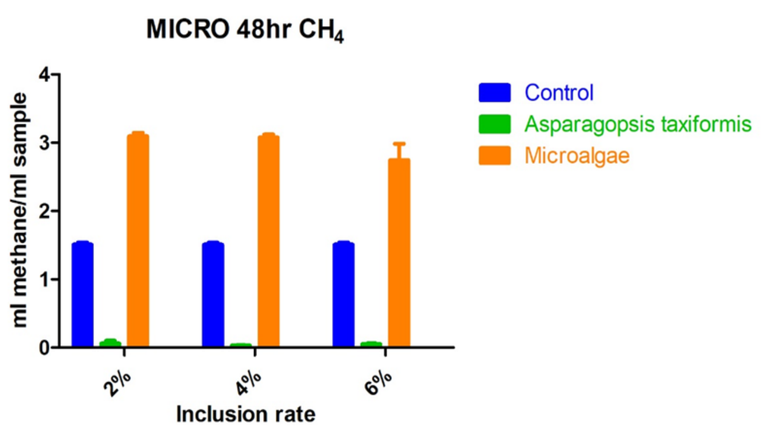
Results & Conclusions

CH_4 abatement assay

At the 3.5hr time-point post incubation, the 2% inclusion rate of *Chlorella* sp. in grass silage significantly reduced CH_4 ($P<0.01$) production. At the 24hr time-point, the microalgae significantly reduced CH_4 across all inclusion rates ($P<0.001$) in comparison to the grass silage control containing no algae. However, at the 48hr time-point, the microalga and silage concentrate test significantly increased CH_4 production at all inclusion rates (2, 4 and 8% inclusion rates, $P<0.001$).







Antihypertensive trial in dogs

This trial is on-going and will be complete by October 2023. Cyclooxygenase inhibition *in vitro* was used to select microalgae for inclusion in a carrier treat (biscuit type product) for use in the trial. *Chlorella* sp. and *Nannochloropsis* sp. were selected for use at an inclusion level of 4% of total weight of the treat product based on COX-1 and COX-2 inhibition values obtained *in vitro*. COX inhibition values > 40% were obtained using a concentration of 1 mg/ml whole microalgae.

IDEA - Implementation and development of economic viable algae-based value chains (NWE639)

Duration: 9/2017 – 10/2021, capitalisation till 12/2023

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Lead partner: VITO, Belgium

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