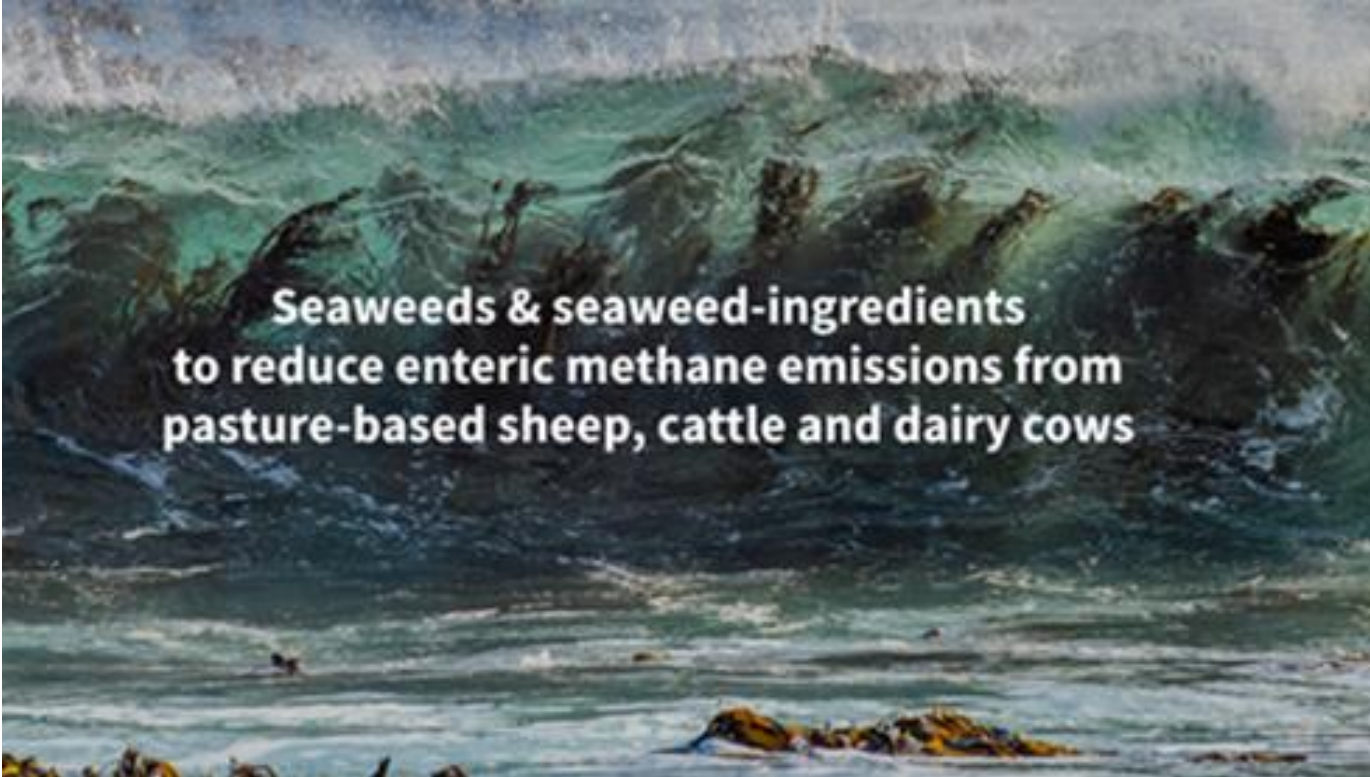




SEASOLUTIONS





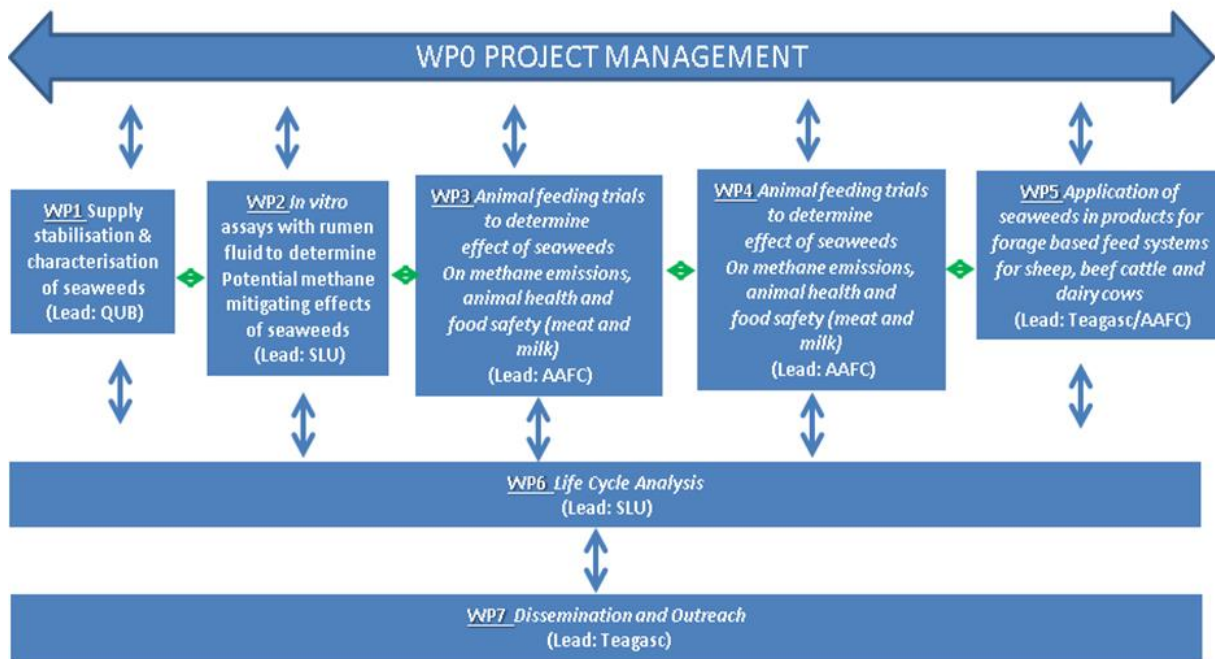
Seaweeds & seaweed-ingredients to reduce enteric methane emissions from pasture-based sheep, cattle and dairy cows

SEASOLUTIONS CONSORTIUM

Participant No	Participant organisation name	Short name	Country
1	Teagasc – The Irish Agricultural and Food Development Authority	Teagasc	IR
2	Queen’s University Belfast	QUB	UK (NI)
3	Agri-Food and BioSciences Institute	AFBI	UK (NI)
4	Swedish University of Agricultural Sciences	SLU	SWE
5	SINTEF	SINTEF	NO
6	Norwegian Institute of Bioeconomy Research	NIBIO	NO
7	Agriculture and Agri-Food Canada	AAFC/AAC	CAN
8	Institute of Technology Sligo	IT Sligo	IR
9	Friedrich-Loeffler-Institut	FLI	DE



PROJECT WPS & IMPLEMENTATION



WP1: Supply, stabilisation and characterisation of seaweeds - Lead partner QUB

T1.1 Development of standard SOP for harvest and supply of seaweeds (M1-6; Teagasc, QUB, SINTEF, AAFC, NIBIO, SLU).

T1.2 Evaluation of preservation technologies on bioactive and methane mitigating constituents (M1-12; lead Teagasc, all WP leaders).

T1.3 Quantification of potential methane mitigating and toxic constituents (M6-18; Teagasc, QUB, SINTEF, AAFC, NIBIO, SLU).

T1.4 Processing to enrich bioactives, data collection and provision of seaweeds to WP2 (TM6-24; QUB, Teagasc, all WP partners).

WPI: Supply, stabilisation and characterisation of seaweeds - Lead partner QUB

In: Raw material



Stabilise



Extract



Dry



Characterise structure



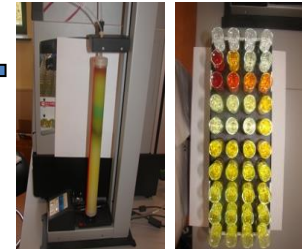
Purify further



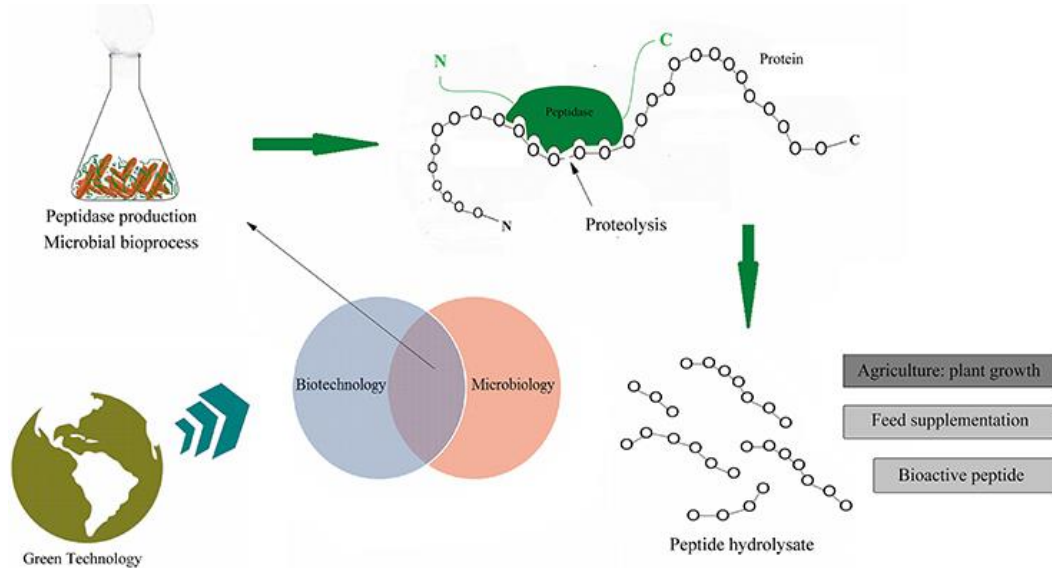
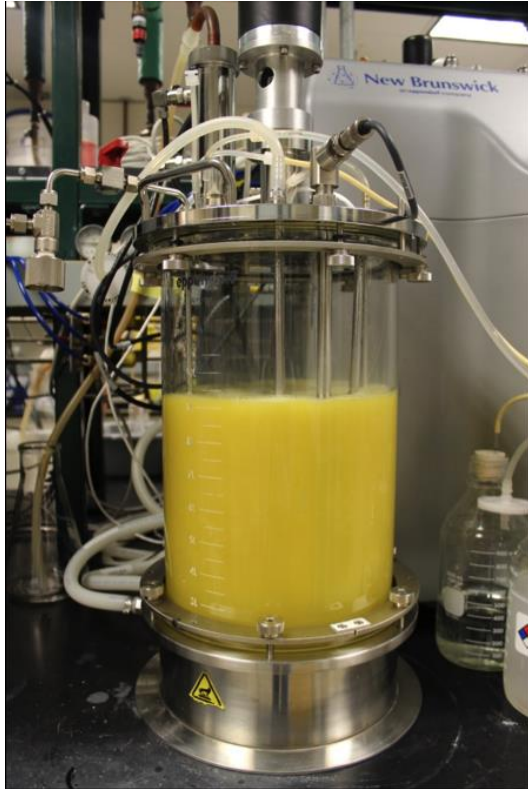
In vitro bioassay



Enrich & Purify



Silage, Fermentation, Hydrolysis technologies



- Hydrolysate technology can offer smaller processors a cost effective method to handle feed materials.
- Produce high quality oils and protein for food, feed and fertilisers.

Task 1.3: Quantification of Phlorotannins

- 10 samples of treated seaweeds supplied by SINTEF
- Irish seaweed samples (5 brown species – SS1, SS4, SS5, SS6, SS7)
- QUB seaweed samples (7 samples)
- Initial results (next week – Irish samples)
- SINTEF results (October)
- QUB results (November)

TPC extracts (dried) – lipid removed (hexane);
acetone:water (70:30 v:v TPC extract)

Methanol:cellulose extraction & drying 30°C

Toluene extraction (pigments); dry 30°C

Acetone: water (70 : 30 V:V) Phlorotannins
(purified)



Ulva intestinalis
Gut weed



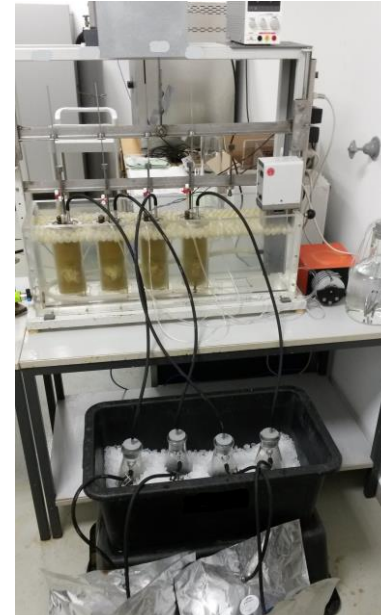
Fucus spiralis
Spiral wrack



Ascophyllum nodosum
Knotted wrack

WP 2: *In vitro* assays with rumen fluid to determine potential methane mitigating effects of seaweeds/seaweed enriched fractions

- **T2.1** *In vitro* rumen simulation techniques to measure methane emissions (M6-18; Lead: SLU with AAFC, QUB and Teagasc).
- **T2.2** Ranking of seaweeds based on efficiency in reducing emissions *in vitro* (M6-18; lead QUB, SLU, all WP leaders).
- **T2.3** To develop palatable “lick”/flake and pellet type products in conjunction with industry partners (Teagasc).

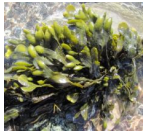


Rusitec System
FLI

T2.1 *In vitro* rumen simulation techniques to measure methane emissions (M6-18; Lead: SLU with AAFC, QUB and Teagasc)



Ulva intestinalis
Gut weed



Fucus spiralis
Spiral wrack



Seaweed/extract supply (Teagasc)



Rusitec (Teagasc Grange); SLU



Ash analysis – 64 samples

WP 3: Animal Feeding Trials to determine effect of seaweeds on methane emissions, animal health & food safety

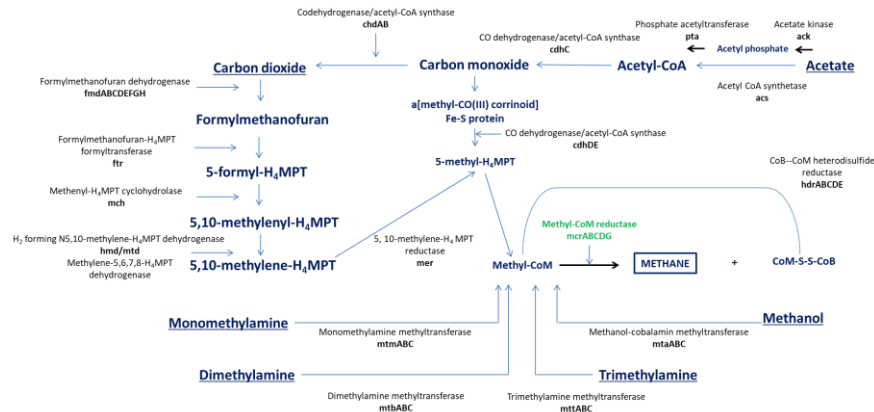
- **T3.1** *In vivo* assessment of anti-methanogenic potency of seaweed/seaweed fractions from WP1& 2 in sheep (Teagasc, NIBIO, M32).
- **T3.2** *In vivo* assessment of anti-methanogenic potency of seaweed/seaweed fractions from WP1& 2 in beef cattle and dairy cows (AAFC, Teagasc, FLI, SLU, QUB M32).
- **T3.3** Quantification of bromoform, lipid and seaweed bioactives in end food products (meat and milk) (Teagasc, QUB, AFBI, AAFC M36).





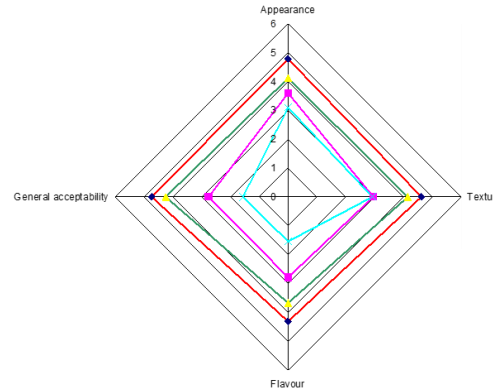
WP4: Impact of seaweed on rumen microbiota

- **T4.1 Sequencing of the rumen microbiome of sheep, beef cattle and dairy cows fed seaweeds in WP3.** (Teagasc, AAFC, QUB, SLU, M35).
- **T4.2 Processing of metagenomic and metatranscriptomic data** (QUB, SLU, M36).
- **T4.3 Profiling of rumen metabolomes** (SINTEF, M36).
- **T4.4 Modelling of ruminal microbial interactions** (QUB, Teagasc, SLU, M36).



WP5: Application of seaweed in products for forage based feed systems for sheep, cattle and dairy cows

- T5.1 To determine the palatability and uptake of pelleted, flaked and lick seaweed/seaweed bioactive containing products developed in WP2 by sheep, beef cattle and dairy cows.



WP 6: Life Cycle Analysis (LCA)

- T6.1 LCA analysis of seaweed production through to seaweed feed product development and measure of impact on methane emissions and global warming (SLU, AAFC, all partners, M36).



WP 7: Dissemination & Outreach

- Workshop (M18) & closing seminar (M36) – target farmers.
- White papers, websites (M12) and other dissemination portals – Government bodies.
- Presentation of SEASOLUTIONS results at BSAS conferences (M18, M36).
- Scientific publications.



Economic and Life Cycle analysis will be looked at in depth. (U) SEASOLUTIONS will encourage more efficient use of local seaweed (feed sources) in livestock feeding. These solutions will be achieved by the combined efforts of internationally recognised scientists, industry participation, use of ICT in animal feeding studies (IRIGM system, metabolic chambers equipped with gas chambers and data acquisition systems, use of RFID tags in feeding trials and remote monitoring of methane emissions using GreenFeed systems).

OUR OBJECTIVES

- To develop novel, science based, and implementable approaches to reduce methane emissions from sheep, beef cattle and dairy cows through seaweed additions to animal diets.
- To explore more futuristic options (e.g., development of seaweed feeds from seaweeds produced through aquaculture pond systems) based on emerging knowledge and technologies and by monitoring rumen pH and methane emissions using sensor technologies and capture of this data from animal trials using ICT technologies.
- To harvest and preserve native, sustainable seaweeds, in sufficient quantities (500 kg/2000 kg dry weight) for use as ingredients/raw material for animal feed development through implementation of drying, milling and novel technologies (High pressure processing, accelerated solvent extraction).
- To characterise and select native seaweeds for in vitro and animal trials based on their bioactive and safety profiles. The constituent composition of selected seaweeds will be quantified in terms of their peptides, phlorotannins, bacteriocin, bromofuran, lipid and small molecule content using chromatography, mass spectrometry and 2D-NMR methods.
- To evaluate effects of seaweeds on total methane gas production using different in vitro rumen fluid models and animal trials. This has not been tested stringently in animal experiments with seaweeds other than *Asparagopsis* sp. which is not abundantly available (in sufficient quantities) in Europe. ICT technologies will be used in trials where sensors will be used to capture rumen pH, methane emissions and other data which will be captured and analysed using ICT methods.
- To examine the positive nutritional contributions of algae in the diets of sheep, cattle and dairy cows and the impact on milk and meat.
- To understand the mechanisms of action evoked by seaweed inclusion in the diets of sheep, beef cattle and cows in terms of the underlying role of the rumen microbiome. We will use rRNA taxonomy approaches to monitor bacterial and eukaryotic differences post feeding of seaweed (i.e. Who is possibly responsible?) as well as monitoring functional differences using metagenomics and metatranscriptomics (i.e. Which genes are possibly involved).
- To explore novel options for methane reduction and to develop feed ingredients (pellets, licks and flakes) for use by farmers to reduce emissions and improve animal health and nutritional efficiency.
- Political instruments: Our aim is to recommend adequate policy instruments (incentives or regulations)



We aim to evaluate effects of seaweeds on total methane gas production using different in vitro rumen fluid models and animal trials.

SUSTAINABILITY

Sed ut perspiciatis unde omnis iste natus error sit voluptatem accusantium doloremque laudantium, totam rem aperiam, eaque ipsa quae ab illo inventore veritatis et quasi architecto beatae vitae dicta sunt explicabo. Nemo enim ipsam voluptatem quia voluptas sit aspernatur aut odit aut fugit, sed quia consequuntur.

[Read More](#)



An Rannán Talmhaíochta,
Eolaíochta agus Mara
Department of Agriculture,
Food and the Marine



Agriculture and
Agri-Food Canada



IGFS THE INSTITUTE FOR GLOBAL FOOD SECURITY



FRIEDRICH LÖFFLER INSTITUTE
FLI
Forschungsinstitut für Tierernährung
Federal Research Institute for Animal Nutrition
Institute of Animal Nutrition

- Review paper submitted for publication in *Animals*
- Planning workshop for M18.



1 *Type of the Paper (Review)*

2 **Seaweed bioactive ingredients for mitigation of**

3 **enteric methane: Challenges and Opportunities**

4 Maria Hayes ^{1*}, Pamela Walsh ², Katerina Theodoridou ³, Stuart Kirwan ⁴, Sinead Waters ⁵,

5 Karen A. [Beauchemin](#) ⁶, Robert [Gruninger](#) ⁷, Stuart Kirwan ⁸, David Kenny ⁹, Sharon Huws ⁸, D.

6 Wade Abbott ⁶, [Xiaohui Xing](#) ⁶, Vibeke Lind ⁷, Inga Marie Aasen ⁵, Mohammad Ramin ⁹, Dirk

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23

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THANK YOU

GRACIAS

ARIGATO

SHUKURIA

BOLZIN

MERCI

DANKSCHEEN

TASHAKKUR ATU

YAQHANYELAY

SUKSAMA

MEHRBANI

MAAKE

GRAZIE

BIYAN

SHUKRIA

TINGKI

SPASSIBO

SHACHALMIYA

HURUH

CHALTU

WABEEJA

HAIYEKA

HUI

YUSPANGAHTAM

DIIBRYABAD

ANIKI

ATTO

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