Harnessing the power of seaweed to improve gut health

Golden kelp, *Ecklonia radiata.*

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Funding
This research was funded by the Research Leaders 2025 programme, co-funded by Teagasc Ireland and the EU's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement number 754380.

Collaborators
- Dr Maria Hayes, Teagasc, Dublin, Ireland
- Dr Sarah Hotchkiss, CyberColloids, Carrigaline, Co Cork, Ireland
- Dr Michael Conlon, CSIRO, Adelaide, Australia

Bio
I am a natural-products chemist specialising in algal bioactive compounds for nutraceutical and functional food applications. Currently, I am completing a Marie Skłodowska-Curie postdoctoral fellowship on Irish and Australian seaweeds as a source of novel bioactives for gut and metabolic health.

Further reading
Shannon, E, et al, (2022) The prebiotic effect of Australian seaweeds on commensal bacteria and short chain fatty acid production in a simulated gut model. *Nutrients*, 14(10), 2163.

Shannon, E, et al, (2021) Seaweed components as potential modulators of the gut microbiota, *Marine Drugs*, 19(7), 358

Teagasc Research Leaders 2025 Projects, (2021) SeaHealth – Seaweed as a source of novel bioactives for gut and metabolic health, www.teagasc.ie/about/research--innovation/research-leaders-2025/funded-projects/seahealth

Shannon, E, et al, (2021) SeaHealth – The benefits of seaweed for our gut, *Teagasc T-Research*, 36.

Shannon, E, et al, (2022) ICFD abstract: *The prebiotic effect of Australian seaweeds on bacterial abundance and short chain fatty acid production in a simulated gut model.*

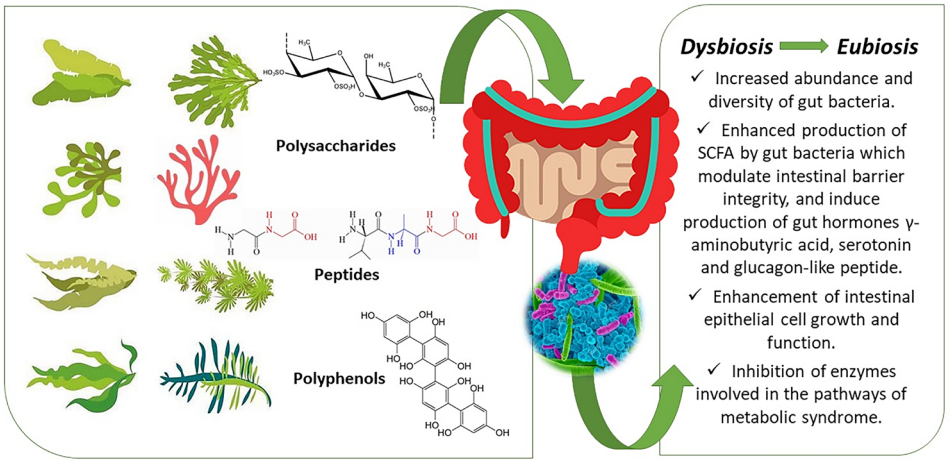
Teagasc
Agriculture and Food Development Authority

Photo credit: Jo Lane

Crayweed, *Phyllospora comosa*, collected from Bermagui Beach, New South Wales, Australia.

Harnessing the power of seaweed to improve gut health

- The bacterial ecosystem in the gut, the microbiome, underpins human health, and the right diet can increase the beneficial bacteria found there.
- Seaweed has unique prebiotic properties that promote the growth of these beneficial bacteria.
- Together with colleagues, Dr Emer Shannon, at the Irish Agriculture and Food Development Authority, is exploring the potential of seaweed for improving gut health.



Polysaccharides, polyphenols, and proteins from seaweed can alleviate dysbiosis of the gut microbiome and enhance immune status.

The phrase 'you are what you eat', may not be strictly true, but researchers are only just realising the full impact of nutrition on our health. As our understanding has increased, we have begun to appreciate the role of the vast collection of bacteria, fungi, and viruses that live in our digestive system. This is the gut microbiome; a complex ecosystem that can influence more than just digestion, and which is often referred to as our second brain.

The full capabilities of the microbiome are still being explored, but research has shown it may influence metabolism, immune responses, and even mental health. For example, metabolic disorders, such as high blood pressure, type 2 diabetes, and obesity are associated with a disrupted balance of the gut microbiota. While it is not known whether this is cause or effect, or a combination of both, increasing the beneficial bacterial species in the microbiome may have significant health benefits, and offer an attractive treatment option to replace reliance on medications.

Given its importance for human health, how can a healthy gut microbiome be achieved? One way is through prebiotics, compounds that fuel the growth and survival of the beneficial bacteria in the gut.

Feeding the gut microbiome

Dr Emer Shannon, at Teagasc, the Irish Agriculture and Food Development Authority, is exploring the prebiotic effect that seaweed may have on the gut microbiome. Shannon is working alongside Teagasc colleague Dr Maria Hayes, Dr Sarah Hotchkiss from CyberColloids, Ireland, and Dr Michael Conlon from the Commonwealth Scientific and Industrial Research Organisation, on a project called SeaHealth.

Shannon explains that whole seaweeds, as well as substances derived from seaweed, contain prebiotics such as polysaccharides (a type of carbohydrate) and polyphenols (which have antioxidant properties in addition to prebiotic activities). Prebiotics are sometimes classed as functional foods, foods which offer health benefits beyond their nutritional value. Among other investigations, SeaHealth will screen seaweed extracts for their impact on metabolic health, as well as their potential for prebiotic activity.

A secret superfood?

One part of the SeaHealth project focuses on the prebiotic properties of three types of seaweed, the Australian brown seaweeds *Phyllospora comosa* and *Ecklonia radiata*, and the green seaweed *Ulva ohnoi*. As well as looking at the whole seaweed, the team also extracted polysaccharides and polyphenols and carried out a variety of different analyses.

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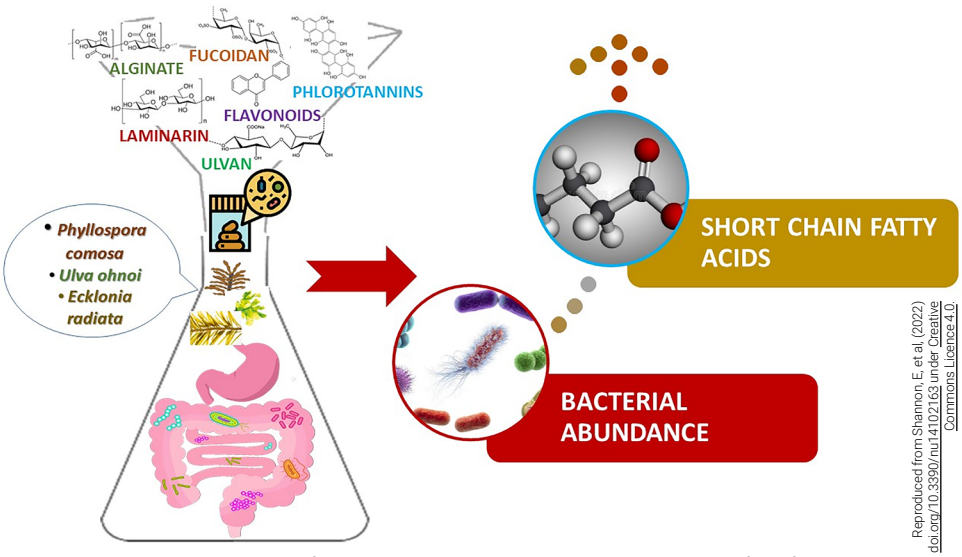


Polysaccharides and polyphenols from brown and green seaweeds enhance the abundance of beneficial bacteria and their production of short chain fatty acids in the gut.

Firstly, they subjected the samples to digestion with enzymes, as would normally occur in the human stomach and upper digestive tract. The researchers were also able to recreate a working human gut in the laboratory – which included human faecal matter – to simulate the way in which food products are fermented in the large intestine by our gut bacteria.

The team used a special kind of genetic sequencing, which can differentiate between each species of bacteria, to monitor the impact the seaweed and extracts were having on the bacteria in the model gut. This included looking at which populations of bacteria increased and decreased, as well as the overall diversity within the microbiome.

Several different groups of beneficial bacteria were increased after seaweed or its extracts had been applied. These groups of bacteria are especially important because when they ferment and break down indigestible foods, such as prebiotics, they produce short chain fatty acids (SCFA). SCFA, especially butyrate, are well known for their role in improving gut health. One way they do this is by providing energy for the cells in the gut, but they also regulate the production of some immune cells and may even have positive impacts on behaviour and neurological health.

After 24 hours of fermentation, the levels of many beneficial bacteria including Actinobacteria, and lactic acid-producing probiotic Firmicutes, had increased when the gut was exposed to seaweed compared to a standard prebiotic control. This corresponded to an increase in SCFA production when compared to the control samples.

As well as an increase in good bacteria, Shannon and colleagues found that overall diversity within the microbiome increased. This is important because previous research has shown that more diversity means a more stable microbiome; if one type of bacteria should disappear there's more chance another type of bacteria will be able to step in and carry out the same role.

Plant-based medicines

Seaweed represents a sustainable, often underused source of compounds with therapeutic properties, many of which are not found in terrestrial plants. The wider SeaHealth project aims to use seaweed to develop functional foods – foods that have enhanced nutritional profiles and health benefits while still looking, smelling, and tasting acceptable to consumers.

Shannon and colleagues have demonstrated that whole seaweeds and their extracts may be able to improve gut health, and even have knock-on benefits for other aspects such as immune function. Now that this has been tested in the lab, the next steps may involve testing the same ingredients in human participants.

Personal response

Can you tell us what first drew you to researching seaweeds?

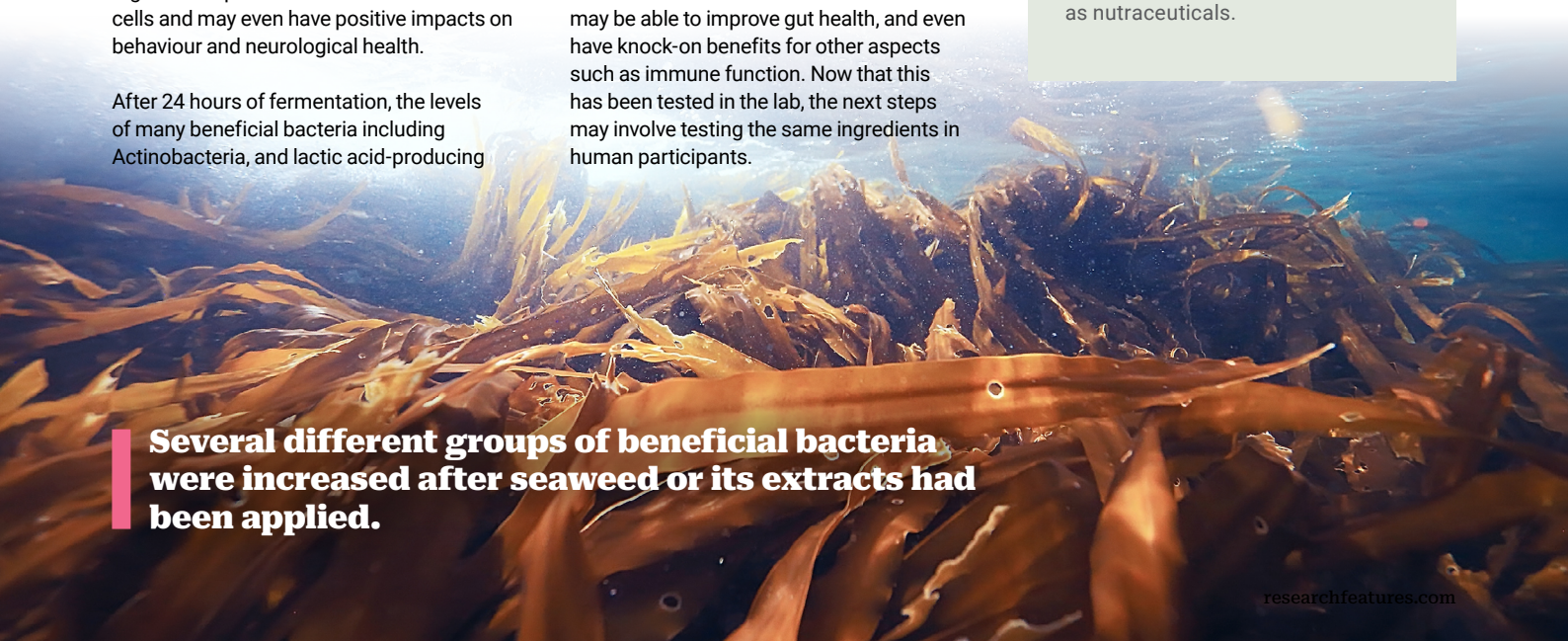
Seaweeds and the ocean have always fascinated me as a source of health promotion and wellbeing. I wanted to study the bioactivity aspects of seaweeds after my Bachelor of Science degree, and was very fortunate to be awarded a PhD scholarship to do so. Following on from this, I wrote a proposal for seaweeds as modulators of gut and metabolic health, which was accepted as a Marie Skłodowska-Curie postdoctoral fellowship.

What plans do you have to test your lab results on humans?

My project is coming to an end soon, but the data generated from my *in vitro* work paves the way for further investigation in the form of dietary intervention trials with animals, and then human clinical trials. This would involve measuring biological endpoints – before and after inclusion of seaweed extracts in the diet – such as microbiome health, blood pressure, glucose tolerance, cholesterol levels, and other indicators of health status.

Which aspects of your research excite you most and why?

Working with underutilised seaweed species from all over the world to find bioactivity for health applications. The experiments that don't have the expected outcome in the lab are often the most interesting and productive as they raise new questions that can lead to useful discoveries. There is a definite potential for plant extracts, both marine and terrestrial, to function as nutraceuticals.



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