Seaweed diseases: understanding seaweed host-pathogen interactions to improve commercial seaweed production

Supervisory team:
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Host institutions: University of Exeter (Penryn), Plymouth Marine Laboratory

Submit applications for this project to the University of Exeter

Project description:

Seaweeds are the new superfoods, being a rich source of minerals, vitamins, proteins and fibre. Seaweed aquaculture is receiving increasing attention and is rapidly expanding in Europe, including in the South West of the UK. However, like land plants, seaweeds are susceptible to infectious diseases, resulting in major losses to multi-billion-dollar crops such as nori. Finding solutions to prevent or treat such outbreaks is thus crucial. To do so, it is vital to understand the ecological drivers of seaweed diseases and the interactions between the pathogen, its host, and the beneficial microbes associated with the host. Seaweeds together with their surface associated beneficial bacteria can produce suite of antimicrobials to defend against pathogens and pro-microbials to attract beneficial bacteria (Figure 1).

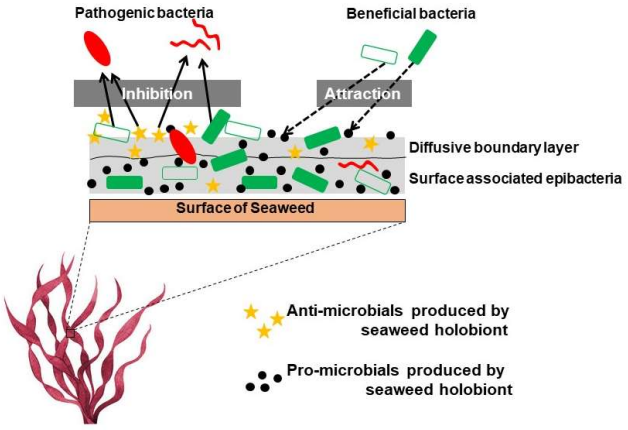

Figure 1: Conceptual diagram illustrating the role of pro-microbials and anti-microbials in attraction of beneficial epibacteria and deterrence of detrimental bacteria like pathogens. Note: not drawn to scale.

Our research has shown that this defence capacity of seaweed holobionts is dynamic and can be altered by changing abiotic factors during culture conditions, increasing growth of the seaweed and decreasing infection by pathogens. Using sugar kelp (one of the most cultivated kelps in the EU) and dulse (the most sought-after culinary seaweed with an increasing market demand), you will (a) test different abiotic regimes to enhance defence capacity and thus minimize infection in sugar kelp and dulse (O1 and 2), (b) identify the antimicrobials (from both seaweeds and the beneficial associated microbes) contributing to defence capacity (O3 and 6), (c) map metabolic information and identify upregulated and/ downregulated metabolites between healthy and diseased individuals (O4) and, (d) use high-throughput sequencing to characterize the microbiota of healthy and diseased individuals (O5).

This project will test seaweed-pathogen interactions using two economically important edible species using an interdisciplinary approach combining chemical ecology, microbiology, analytical chemistry and statistical tools. This knowledge will contribute to improving aquaculture practices and maximize farming yield in the south west of UK and beyond.

Training: While rotation project 1 will provide you with skills in running Quorum Sensing (QS) assays with application in biofilm industry, rotation project 2 will train you for anti-microbial resistance (AMR) work using an important virulence model. During your PhD, you will develop advanced lab and field research skills plus transferable skills (e.g. infection bioassays, amplicon sequencing and mass spectrometry) to support a future career in academic research/teaching or the biotech and agritech industry.

Person specification: This project would suit a curious, highly motivated, self-reliant student. A biochemical background and interests in commercial exploitation and food security issues would be ideal.