

Food Value Chain

Vision Statement:

The marine microbiome will be key to securing and facilitating sustainable production of food from our oceans

Background

Human populations are rapidly growing, and with them the demands for marine food resources. Microbes are key to securing the marine food supply in an ecologically sustainable way. They provide essential nutrients to entire food webs, recycle waste products, and form protective layers on and in larger organisms. Although marine fisheries (including fish and shellfish) and the use of seaweeds are many eons old, the direct application of individual or communities of microbes to facilitate healthy marine food production is still in its infancy. This emerging status, together with our current knowledge on the essential interactions of microbiomes with their hosts and our awareness of the fragility of many of Earth's ecosystems, offers a great opportunity to develop a strategy that includes sustainability and fair-trade where each participant (farmers, industry, public) can benefit without destroying the natural habitats.

Marine food from fisheries and aquaculture refers to any food source directly or indirectly derived from the marine ecosystem. This includes higher organisms (grown on fish farms, shellfish farms, crustacea farms) and algae (seaweeds and micro-algae). Marine food production is not limited to the open waters of seas and oceans. Rising seawater levels put more coastal regions under the direct influence of saltwater, including upwelling saline groundwater. Novel developments in saline agriculture where salt tolerant crops are amended with salt tolerant microbiomes could save these regions from desertification. Studies on marine food-associated microbiomes are far behind current state-of-the-art research in terrestrial, fresh water-based agriculture and human plus cattle related microbiome studies. Catching-up requires investments and effort from policy, industrial researchers and scientists.

Goals:

- Advance the scientific understanding of microbiomes associated with or applied to marine food production to be on par with that of agricultural and human systems
- Develop novel technologies to apply microbiomes for healthy eco-friendly marine food production
- Integrate microbiome monitoring in the management of sustainable marine food production
- Increase the ability of food producers (both small and large scale) to leverage microbiome technologies to promote stock health and productivity

Specific objectives:

- Provide a wide inventory of various marine derived food sources and existing technologies in marine aquaculture. A complete inventory is needed to identify essential growth parameters between food source, microbiome and ecosystem and of local markets and preferences in marine food consumption.
- Provide an inventory of existing programs involving marine microbiomes for sustainable food production from the USA, Canada and the EU and their targeted model systems to enhance communication and accelerate progress.

- Harness marine microbiomes to move past traditional, non-sustainable agriculture and develop marine food-related applications that balance long-term services with ecosystem preservation.
- Develop novel microbiome related technologies hand in hand with novel cultivation techniques. Collaboration along and across the Atlantic is key to propel this process and stimulate exchange of knowledge and novel techniques and to include diverse food sources and variations in local ecosystem
- Develop novel tools in high throughput DNA sequencing, bioinformatics and ecosystem modelling to handle the large datasets that will be generated.

Action Items:

- Short-term
 - Raise international, political and public awareness of potential applications of marine microbiomes in sustainable marine food production
 - Encourage universities to initiate targeted marine food microbiome related fields of study and establish novel university chairs
 - Initiate large scale studies to analyse composition and functional diversity of marine food related microbiomes and their role in food and food supplement production
 - Develop and apply new multivariate statistics and meta-analysis for large datasets to understand the relationships between microbiome, host and environment
 - Learn from other microbiome research areas (terrestrial, human, etc.) and transfer relevant results and methodologies to the marine microbiome food production
- Mid-term
 - Development of novel technologies to secure sustainable ecological friendly aquaculture based on circular ecology principles such as Integrated Multi Trophic Aquaculture (IMTA)
 - Develop quick microbiome analysis tools for monitoring and control of microbiomes in aquaculture production facilities
 - Study Impact of novel marine microbiome facilitated food source on human & cattle health (gut microbiome intervention studies)
 - Provide input to update the FAO Code of conduct for responsible fisheries, specifically addressing aquaculture and the role of the marine and freshwater microbiomes
 - Provide access to technical training (e.g. handling microbiomes in relation to aquaculture and big data analysis) and opportunities that inspire entrepreneurship
- Long-term
 - Marketing of marine microbiome derived food as an honest truly eco-friendly, sustainable alternative to traditional food resources
 - Developing a global knowledge hub on marine microbiomes to facilitate access and exchange of data, information and knowledge
 - Free exchange of knowledge and technology to encourage uptake by farmers from small and medium enterprise aquaculture
 - Stimulate sustainable saline agriculture in coastal regions affected by climate change