Cyber-Marine Industry Forum - Final Programme, 6 May 2022

Cyber-physical seafood systems: Intelligent and optimised green manufacturing for marine co-products

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Meeting ID: 936 5468 2621
Passcode: 527427

Time	Presenter	Company	Topic
9:30 am	Sue Marshall	Plant & Food Research (PFR)	Welcome
	Hemi Cumming	PFR	Karakia
	Ivan Kurtovic	PFR	Housekeeping
	Sue Marshall	PFR	Cyber-Marine: Integrating analysis and processing to make the most of our marine bioresources
Session 1: Raw materials			
10:00 am	Mikhail Vyssotski	Callaghan Innovation	Marine lipids – novel product opportunities
	Daniel Killeen	PFR	The challenge of real-time analysis
	Prof. Mengjie Zhang	Victoria University of Wellington (VUW)	Artificial intelligence, machine learning and data science at VUW: Capabilities and applications
	Questions		
11:00	**Break**		**10 minutes**
Session 2 – Building skills and working together within the wider research landscape			
11:10 am	Suzy Black	PFR	Taking a fish-centric approach to growing, harvesting and handling systems
	Hemi Cumming	PFR	Cyber-Marine student outreach programme
	Anna Yallop	Bioresource Processing Alliance	The Bioresource Processing Alliance – Extracting value from by-products
	David Aitchison	Trinder Engineering	Summer intern driven collaborations – An effective means to an end
	Prof. Colin Barrow	Deakin University (Geelong, Australia)	Marine bioproducts and bioprocessing in Australia
	Questions		

12:15 pm	**Lunch break**		**30 minutes**
Session 3 – Integrating current and new processing technologies			
12:45 pm	Andrew Stanley	Sanford	Sanford Bioactives - scaling up our extracts future
	Owen Catchpole	Callaghan Innovation	Extraction of lipids from partially to fully dried marine biomass using supercritical fluids
	Bodhi Bettjeman	PFR	Integrating processes to deliver multiple products
	Questions		
Session 4 – Beyond "products as usual"			
1:30 pm	Elley Rudebeck	Deakin University (Geelong, Australia)	Functional glycolipids from marine material using green solvents
	Iain Hosie	NanoLayr	Taking a novel NZ marine product to market
	Mathew Cumming	PFR	Alchemy of marine extracts: Spinning fish into gold
	Questions		
~2:15	Sue Marshall		Wrap up
	Hemi Cumming		Close
2:30 pm	Finish		

Abstracts

9:45 am, Introduction

Dr Sue Marshall. Science Group Leader, Seafood Processing & Marine Products, Plant and Food Research. Programme Leader *Cyber-Marine*. Leader Research Aim 1.3.
Cyber-Marine: Integrating analysis and processing to make the most of our marine bioresources. Cyber-physical seafood systems: Intelligent and optimised green manufacturing for marine co-products (Cyber-Marine) is a 5 year research programme funded by The Ministry for Science Technology and Employment though the Endeavour Scheme. It is a collaboration between Plant and Food Research (PFR), Callaghan Innovation, University of Otago, Victoria University of Wellington and Deakin University in Australia.
The Cyber-Marine research team and industry partners are developing integrated analysis and advanced manufacturing technologies to overcome challenges with NZ's marine biomaterial diversity (e.g. multiple species with totally different morphology, seasonal effects, variable by-products from filleting). We're identifying the gaps in existing processing technology that leave valuable molecules in rendering streams and bringing together existing and new technologies to allow development of a biorefinery for marine products. The ultimate goal is an energy-efficient 'green' factory capable of processing any marine organism, whether whole animal or by-product via multi-product processing cascades. Our 'future factory' for marine co-products is automated, low energy, non-polluting, able utilise any raw material, and delivers optimal value for every kg of input.

10:00 am, Session 1 - Raw Materials

Dr Mikhail Vyssotski. Distinguished Research Scientist at Callaghan Innovation.
Marine lipids – novel product opportunities. Marine organisms offer immense opportunities of developing high value products for both consumer health applications and bioprocessing industries. An impressive body of scientific knowledge accumulated in the area suggests that today's seafood processing by-products and by-catch may be considered as a treasure trove of future dietary supplements.

Dr Daniel Killeen. Research Team Leader Marine Products Chemistry, Plant and Food Research. Leader Research Aim 1.1.
The challenge of real-time analysis. Optimal usage of a biomass is a function of its composition. In Cyber-Marine we will establish: How much we can know; how quickly we can know it; and how can we use this information to inform optimal processing.

Prof. Mengjie Zhang. Professor Computer Science. Associate Dean (Research and Innovation), Faculty of Engineering, Victoria University of Wellington. Leader Research Aim 1.2.
Artificial Intelligence, Machine Learning and Data Science at VUW: Capabilities and Applications. Overview of the VUW research on articifical intellegnce (AI), machine learning and data science. This includes: the main people; the six major technology themes (several of which will be used for this Cyber-Marine programme); five key application themes; and connections with industry.

11:10 am, Session 2 - Building skills and working together within the wider research landscape

Dr Suzy Black. Science Team Leader Physiology & Post-harvest Science, Plant and Food Research. Programme Leader *Reimaging Aquaculture*

Taking a fish-centric approach to growing, harvesting and handling systems. By putting the fish at the centre of the design process and specifically designing growing, harvesting and handling systems that support the biological needs of fish, comes the ability to contribute to the transformation of our seafood and aquaculture industries. This presentation will briefly outline our research in these areas and how increased production and improved quality and consistency can contribute to revolutionizing NZ's supply of fish for food and secondary processing.

Dr Hemi Cumming. Scientist, Plant and Food Research.

Cyber-Marine student outreach programme

Māori make up only a small percentage of those that continue on to a career in STEM (Science, Technology, Engineering & Mathematics). This presentation will discuss two initiatives we have incorporated into Cyber-Marine, providing opportunities for students to get hands-on exposure and experience in science research.

Anna Yallop. General Manager, Bioresource Processing Alliance

The Bioresource Processing Alliance – Extracting Value from By-products. The Bioresource Processing Alliance (BPA) is an R&D programme funded by the Ministry of Business, Innovation and Employment (MBIE). The BPA takes biological by-products from the primary sector and converts them into high value products. The BPA's General Manager Anna Yallop will give an overview of the BPA, discuss the types of projects the BPA undertakes, and will explain ways that companies working with marine sources can extract higher value from the raw material.

Dr David Aitchison. Research & Innovation Manager, Trinder Engineering

Summer Intern driven collaborations – An effective means to an end. Technical challenges that are not on a project's critical path and within a team's field of expertise may often be overlooked, despite there being significant benefits in a well-developed solution. Plant & Food Research partnered with Trinder Engineering and the University of Canterbury, over the summer of 2021/22, to secure intern funding from Bioresource Processing Alliance (BPA) to tackle one such project - development of a process flow monitoring window for in-line spectroscopy. This presentation illustrates the journey, achievements and benefits.

Prof. Colin Barrow. Alfred Deakin Professor and Chair in Biotechnology, Deakin University, Geelong, Victoria, Australia**.**

Marine Bioproducts and Bioprocessing in Australia. Considerable recent investment has been made by the Australian government in both the marine biotechnology sector and advanced manufacturing. We have leveraged this toward developing a marine bioproducts industry centred around innovative bioprocessing technology for Australian marine biodiversity. We are working collaboratively with New Zealand, particularly through Plant & Food Marine Products, to ensure transfer of expertise and know-how between two countries with valuable marine resources.

12:45 pm, Session 3 - Integrating current and new processing technologies.

Andrew Stanley. General Manager Innovation, Sanford Ltd.
Sanford Bioactives - scaling up our extracts future.
Dr Owen Catchpole. Team Leader, Food Processing Technology, RTS. Chief Engineer, Integrated Bioactive Technologies, Callaghan Innovation. Leader Research Aim 1.5**.**
Extraction of lipids from partially to fully dried marine biomass using supercritical fluids.
The extraction of omega-3 lipids and phospholipids from marine biomass is challenging because the lipid content is low, the lipids are prone to oxidation, and the biomass is mostly water. The marine biomass needs to be dried, preferably using freeze-drying to avoid oxidation. We are investigating extraction of lipids from homogenized and freeze-dried Jack Mackerel (JM), Hoki frames (HF) and green shell mussel (GSM) meat using supercritical CO_2 ($scCO_2$) as the baseline; and mincing of frozen GSM meat, partial freeze-drying followed by subcritical dimethyl ether (DME) as a new combined process technology. Neutral oil yields of 16, 12 and 6 % by dry mass were obtained using $scCO_2$ from JM, HF and GSM respectively, with omega-3 contents of 27, 22 and 42 % but no phospholipids were extracted. Extraction of GSM using the new combined process technology gave total dry basis lipid yields of 13.8 (fully wet biomass) to 11.5 % (9 % moisture) with approximately 40 % omega-3 content and 88 to 65 % extraction efficiency for total phospholipids.

Bodhi Bettjeman. Research Technologist, Plant and Food Research.
Integrating processes to deliver multiple products.
Marine products manufacturing usually focuses on delivery of a single main product (e.g. fillet or GSM oil) with the components in the residual biomass damaged by processing, and often unable to meet premium product specifications. We are working towards multi-component cascades where all molecules of interest can be extracted with their functionality retained. This requires an understanding of the components and what affects their structure. This is then used to design extraction conditions with a focus on gentle, low-energy processing, the order of unit operations to deliver different outcomes, and addressing knowledge/technology gaps that prevent full utilisation.

1:30 pm, Session 4 - Beyond “products as usual”

Dr Elley Rudebeck. Post-doctoral researcher, Deakin University (Geelong, Australia)**.**
Functional glycolipids from marine material using green solvents. Glycolipids are a class of lipid found in marine material that are of particular interest due to their physical and biological properties. Glycolipids are used as biodegradable surfactants, and are known to exhibit anti-inflammatory and antibacterial activity. As part of Cyber-Marine, we are working to develop methods to synthesise glycolipids that mimic natural marine glycolipids using an enzymatic process and biodegradable, non-toxic solvents.

Iain Hosie. Founder and Director of Nanolayr Limited, previously CEO and Technical Director**.**
Taking a novel NZ marine product to market. Nanolayr has developed “Dermalayr™” – a skincare product based on NZ marine collagen nanofibers. It has proven itself to be the fastest, non-invasive delivery platform for cosmetic products available and is showing excellent growth in key Asian markets. NZ marine nutraceuticals are promising to be an important ingredient platform for Nanolayr’s competitive advantage in years to come. Iain will describe the development journey, commercialization challenges and opportunities for the future.

Dr Mathew Cumming. Research Team Leader Marine Polymer Science, Plant and Food Research. Leader Research Aim 1.4.

Alchemy of marine extracts: Spinning fish into gold. Using 'green' chemical approaches to structural and functional modification the Cyber-marine team is working to enhance and manipulate the functionality of molecules from marine organisms. The aim is 'never seen before' products, crafted to fit new consumer trends and market demand. This presentation will provide a peek into our current research and the concept products we are working on at the moment.