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BOOK OF ABSTRACTS

54th Wefta Conference

12th - 16th October 2026

Reykjavík, Iceland

The Blue Bioeconomy -
Meeting the Challenges
of the Future

54th Wefta Conference

12th - 16th October 2026

Reykjavík, Iceland

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Welcome to WEFTA 2026

It is a pleasure to welcome colleagues and friends to Reykjavík for the 54th WEFTA Conference, held from 12 to 16 October 2026. This is the fifth time WEFTA has been hosted in Iceland, following meetings in Reykjavík in 1978, 1979, 1990 and 2003. Since it was founded in 1970, WEFTA has played an important role in connecting the seafood research community. For Iceland, this network has been especially valuable, supporting long-standing collaboration, knowledge exchange and scientific friendships across borders.

The theme of WEFTA 2026 is “Bringing the blue bioeconomy forward.” For Iceland, this is particularly relevant. Fisheries have long been one of the foundations of our economy, while aquaculture is now growing rapidly and creating new opportunities and challenges. At the same time, there is an increasing need to use aquatic resources more efficiently, improve quality and value, reduce losses, and find new uses for side streams and other marine biomass.

The scientific programme reflects these challenges and opportunities, with sessions on micro- and macroalgae, processing technology and monitoring, sustainability and resource efficiency, side stream utilisation, nutrition and consumer insights, underutilised species, and quality and safety of aquatic products. Together, they show how research and innovation can help move the blue bioeconomy from ambition to practice.

WEFTA has always been more than a place to present scientific results. It is also a meeting place where ideas are exchanged, collaborations begin and old connections are renewed. Its relatively small size is part of its strength, creating an open and friendly atmosphere for discussion across generations and disciplines.

Reykjavík is a city closely connected to the ocean, fisheries and seafood innovation. October is a beautiful time to visit Iceland, with autumn colours, changing light and, if we are lucky, the northern lights. We hope you will enjoy both the scientific programme and the opportunity to experience Icelandic nature, culture and hospitality.

On behalf of the organising team, I would like to thank everyone who has contributed to WEFTA 2026 and to extend a warm welcome to all participants.

We hope you will have an inspiring and enjoyable WEFTA week in Iceland.

Welcome to Reykjavík and welcome to WEFTA 2026.

*Margrét Geirsdóttir,
Chair WEFTA 2026*



Margrét Geirsdóttir, Chair WEFTA 2026

Committees

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The WEFTA Award is presented annually to recognise a scientist who has made an outstanding contribution to the WEFTA community and to research in areas such as seafood processing, product development, analytical methods, safety, technology, nutrition, aquaculture and consumer studies. The Chair of the Award Committee will present the 2026 WEFTA Award during the conference dinner on Wednesday, the 14th of October.

WEFTA 2026 Conference Programme

Bringing the blue bioeconomy forward

Place: Fosshotel Reykjavík, Þórunnartún 2, Reykjavík, Iceland

Monday, 12.10.2026

- 14:00 - 16:00 WG meeting
- 16:00 - 18:00 NR meeting
- 18:00 - 20:00 Welcome reception and registration of participants
- 20:00 National Representatives - dinner

Tuesday, 13.10.2026

- 08:30 – 09:00 Registration of participants
- 09:00 – 09:25 Opening Ceremony
 - Margrét Geirsdóttir, Chair of WEFTA 2026
 - Hallveig Ólafsdóttir, Ministry of Industries
 - Oddur Már Gunnarsson, CEO, Mátis

SESSION I. Micro- and macroalgae, nutrition, consumer insights and blue biotechnology

- 09:25 – 09:55 **K01** Johan Robbens, ILVO-Marine, Belgium
 - Algae and the Challenges for Food
- 09:55 – 10:15 **F101** Amelie Heliot
 - Food Safety of Edible Seaweeds: Characterization of the Bacterial Flora Associated with Macroalgae from Northern France
- 10:15 – 10:35 **F102** Hanne K. Mæhre
 - Development of high value food grade sugar kelp (*Saccharina latissima*) production in Northern Norway
- 10:35 – 11:05 **Coffee break, poster session**
- 11:05 – 11:25 **F103** Tom Ståle Nordtvedt
 - Effects of dietary microalgae on fillet quality and nutritional composition of farmed Atlantic salmon

CONTINUATION SESSION I. Micro- and macroalgae, nutrition, consumer insights and blue biotechnology

- 11:25 – 11:30 **S101** Ditte Baun Hermund
 - Scalable biofortification of *Nannochloropsis oceanica* with vitamin D3 using UV-induced conversion
- 11:30 – 11:35 **S102** Solveig Uglem
 - Development of food prototypes containing seaweed
- 11:35 – 11:55 **F104** Morten Heide
 - From Product Development to Market Adoption: Lessons for Go-to-Market Strategies
- 11:55 – 12:00 Buffer / transition

12:00 – 13:00 Lunch break

CONTINUATION SESSION I. Micro- and macroalgae, nutrition, consumer insights and blue biotechnology

- 13:00 – 13:20 **F105** Themistoklis Altintzoglou

- Improving Seafood Confidence Among Young Norwegian Consumers: Effects of Digital Literacy Interventions and Raw Material Transparency on Perceptions of Seafood Value
- 13:20 – 13:40 **F106** Helena Oliveira
Microencapsulated natural seasoning blends as a strategy for sodium reduction in canned skipjack tuna: A 24-month storage stability study
- 13:40 – 14:00 **F107** Antónia Juliana Pais-Costa
Nutrition claims-oriented canned meals from sustainable marine resources
- 14:00 – 14:20 **F108** Anna-Liisa Välimaa
Nutritional Quality of Fermented Fish Products from Baltic Herring (*Clupea harengus* membras)
- 14:20 – 14:40 **F109** Ricardo Pereira
Blue Bioeconomy-Driven Functional Protein Hydrolysates from *Clarias gariepinus*: Physicochemical Profile and Technological Potential for Food Applications
- 14:40 – 15:00 **F110** Inger Beate Standal
Tunicates as a novel feed ingredient for Atlantic salmon

15:00 – 15:30 Coffee break, poster session

CONTINUATION SESSION I. Micro- and macroalgae, nutrition, consumer insights and blue biotechnology

- 15:30 – 15:35 **S113** Torbjørn Tobiassen
Catch Damage and Quality Defects Associated with Different Fishing Gear in the Norwegian Cod Fishery
- 15:35 – 15:55 **F114** Narcisa Bandarra
Valorisation of chub mackerel: seasonal lipid composition and ready-to-eat product
- 15:55 – 16:05 End of day / wrap-up

Wednesday, 14.10.2026

SESSION II. Processing technology, monitoring, quality and safety

- 08:30 – 09:00 **K02** Hildur Inga Sveinsdóttir, Matis and University of Iceland, Reykjavik, Iceland
Processing pelagic fish for consumers - From feed to food
- 09:00 – 09:20 **F201** Jørgen Lerfall
From sub-chilling to tempered thawing: How cold-chain protocols shape quality in Atlantic salmon (*Salmo salar* L.)
- 09:20 – 09:40 **F202** Marcus Hoff Hansen
Industrial Non-Destructive Spectroscopy for Assessing Seasonal Texture-Related Physicochemical Properties of Atlantic Cod (*Gadus morhua* L.) Fillets
- 09:40 – 10:00 **F203** Kristin Beate Hansen
The hidden weight of water in commercial cod catches
- 10:00 – 10:20 **F204** Heidi Anita Nilsen
Robust Prediction of Remaining Shelf Life in Cod Fillets Using Hyperspectral Imaging and Machine Learning

10:20 – 10:50 Coffee break, poster session

CONTINUATION SESSION II. Processing technology, monitoring, quality and safety

- 10:50 – 11:10 **F205** Tone Mari Rode
Impact of Processing Technologies on the Quality and Storage Stability of Texture-Modified Salmon Products
- 11:10 – 11:30 **F206** Yusa Nakamura

	Influence of different resting conditions during intermittent drying on water behavior and quality of salted-dried mullet roe
11:30 – 11:35	S201 Janna Cropotova Effect of cold plasma treatment on quality parameters of fish protein hydrolysates obtained from Atlantic mackerel side streams
11:35 – 11:40	S202 Isabel Sanchez Alonso Thermal Inactivation and Structural Disruption Influence the Fate of Anisakis 4 in <i>Anisakis</i> Larvae during <i>in vitro</i> gastric and gastrointestinal digestion
11:40-11:45	S203 Feijian Liu Comparative Efficacy of Antioxidant Formulations in Preserving the Quality of Baltic Herring Mince
11:45-11:50	S204 Narcisa Bandarra Elemental Composition of Farmed and Wild European Sea Bass (<i>Dicentrarchus labrax</i>): Potential Biomarkers for Production Origin Discrimination
11:50 – 12:00	Buffer / transition

12:00 – 13:00 Lunch break

CONTINUATION SESSION II. Processing technology, monitoring, quality and safety

13:00 – 13:20	F207 Ingrid Undeland Understanding lipid oxidation in macroalgae - case studies with sea lettuce (<i>Ulva fenestrata</i>)
13:20 – 13:40	F208 Ioannis Bozaris Microbial Source Tracking along the Aquaculture Fish Production Chain Using Fingerprinting Approaches
13:40 – 14:00	F209 Foteini Parlapani Omics in Fish/Seafood safety: Modernizing Microbiological Risk Assessment and Regulatory Frameworks for Foodborne Pathogens and Antimicrobial Resistance
14:00 – 14:20	F210 Margrethe Esaiassen Predicting emaciation-related muscle quality in Atlantic cod (<i>Gadus morhua</i>) using Fulton's condition factor and hepatosomatic index
14:20 – 14:40	F211 Cláudia Afonso How Much Seaweed Is Too Much? Finding the Safe Consumption Window with Extreme Value Theory
14:40 – 15:00	F212 António Marques Circular Economy-Based Valorisation Strategies for Parasitized Fish Along the Seafood Value Chain: Black Scabbardfish, Pouting and European Hake as case studies
15:00 – 15:20	F213 Ricardo Pereira Co-occurrence of microplastics and chemical contaminants in canned tuna from the Portuguese market: Implications for dietary exposure and human health

15:20 – 15:50 Coffee break, poster session

CONTINUATION SESSION II. Processing technology, monitoring, quality and safety

15:50 – 16:10	F214 Maria Leonor Nunes Impact of <i>Anisakis</i> spp. infection on quality of black scabbardfish (<i>Aphanopus carbo</i>) fillets assessed through physical parameters
16:10 – 16:30	F215 Léa Specq Immersion infection as a tool to study vibriosis dynamics in juvenile European seabass (<i>Dicentrarchus labrax</i>)

- 16:30 – 16:50 **F216** Hatairad Phetsang
Distribution of PCBs, Dioxins, and PFASs in the Organs of Baltic Herring (*Clupea harengus membras*): Implications for Whole-Fish Utilization
- 16:50 – 17:10 **F217** Sonia Pedro
Contaminant Metals in Marine Bivalves and Gastropods from the South Coast of Portugal
- 17:10 – 17:15 **S205** Narcisa Bandarra
Farmed and wild European sea bass: fatty acid signatures for traceability

Thursday, 15.10.2026

SESSION III. Sustainability and resource efficiency

- 09:00 – 09:30 **K03** Sveinn Margeirsson
Blue Food Futures: How innovation, circularity, and smart resource use can build a more resilient and sustainable food industry
- 09:30 – 09:50 **F301** Cheila Almeida
What makes seafood sustainable? Moving beyond Life Cycle Assessment to assess fish from cellular agriculture, fisheries or aquaculture
- 09:50 – 10:10 **F302** Margrethe Esaiassen
Assessing sustainability in fish processing using TOPSIS: A case study comparing fresh and salted cod production
- 10:10 – 10:30 **F303** António Marques
Eco-innovative technologies for improved security, sustainable production and marketing of agroecological food products in Africa
- 10:30 – 10:35 **S301** Olga Szulecka
Social Labs as a consumer co-creation tool for upcycled food concepts: results from the Up4Food project

10:35 – 11:00 Coffee break, poster session

SESSION IV. Side stream utilisation

- 11:00 – 11:20 **F401** Izumi Sone
Salt-Dependent Cryoprotective Effects of Cod Protein Hydrolysates in Frozen Atlantic Cod Mince
- 11:20 – 11:40 **F402** Simone Corsano
Valorization of enzymatically hydrolyzed cod backbones as a functional ingredient in fish cakes: effects on texture, oxidative stability, and sensory properties
- 11:40 – 12:00 **F403** Janna Cropotova
Prebiotic function and quality parameters of fish protein hydrolysates (FPH) obtained from herring (*Clupea harengus*) side streams by ultrasound pre-treatment before enzymatic hydrolysis

12:00 – 13:00 Lunch break

CONTINUATION SESSION IV. Side stream utilisation

- 13:00 – 13:20 **F404** Brede Bjerke Eiken
Effects of on-board processing of *Gadus Morhua* heads on the storage efficiency and the quality of subsequent enzymatic hydrolysis
- 13:20 – 13:40 **F405** Eva H. Falch
Linking Lipid Stability and Resource Utilisation: A Quality Flow Analysis of Herring Processing Side Streams
- 13:40 – 14:00 **F406** Frederikke Nees Lamberg

- 14:00 – 14:20 **F407** Sherry Stephanie Chan
Future marine food innovation
Effects of sub-chilling on the quality and stability of Atlantic salmon viscera and fillets.
- 14:20 – 14:40 **F408** Inger Beate Standal
What should we do with the dead fish? Safe use of fish mortalities
- 14:40 – 14:45 **S401** Cécile Dargentolle
Freeze-dried salmon liver as a potential health supplement
- 14:45 – 14:50 **S402** Nina Gringer
CRABEX: Sustainable Extraction and Valorisation of European Green Crab Shells for Feed and Food Applications
- 14:50 – 14:55 **S403** Adrián Honrado Frías
Effectiveness of natural and synthetic antioxidants in controlling lipid degradation during fish by-product protein hydrolysate production
- 14:55 – 15:15 **F409** Kathrine Kjos Five
Industrial enzymatic hydrolysis of chicken rest raw materials: effects of process design on protein recovery and product properties

15:15 – 15:45 Coffee break, poster session

CONTINUATION SESSION IV. Side stream utilisation

- 15:45 – 15:50 **S404 Robert Wolff**
From Marine Side Streams to Omega-3 Value Chains: Building Knowledge, Capacity and Industry Engagement Through Student-Led Research
- 15:50 – 16:10 **F410 Andreas Langdal**
Upcycling of Atlantic herring (*Clupea harengus*) side-streams and implications of life cycle assessment goal-statement paradigms. Preliminary findings
- 16:10 – 16:30 **F411 Dušica Vujaklija**, Ruđer Bošković Institute
Screening the Bioactive Potential of Novel Adriatic Sea streptomycetes for Circular Blue Biotechnology Applications

SESSION V. Underutilised species and product innovation

- 16:30 – 16:35 **S501 Elena Garicano Vilar**
Do herring fillets provide sensory benefits in restructured fish products? Evidence from sensory profiling of whole, belly-cleaned, nobbed and filleted Baltic herring fractions
- 16:35 – 16:55 **F502 Carlos Cardoso**
An Upgraded Concept of Sausage with Biological Activity: Combining Chub Mackerel (*Scomber colias*) and Brown Seaweed (*Fucus sp.*) in a Functional Food
- 16:55 – 17:15 **F503 Joana Matos**
Unlocking the potential of underutilised blue resources

17:15 – 17:30 Closing ceremony / WEFTA 2027 announcement

Friday, 16.10.2026

- 08:30 – 17:30 Study tour**

POSTERS

Session 1 – Micro- and macroalgae

P101 Cécile Dargentolle: Green extraction of nanocellulose from Icelandic seaweed for use as sustainable packaging for seafood

P102 Ana Fuentes: Invasive algae: threat or opportunity?

P103 Hanne K. Mæhre: Seasonal and geographical variation in the biochemical composition of Arctic seaweeds over a yearly cycle

P104 Olga Malev: Comparative characterization and bioactivity assessment of phlorotannins from Adriatic brown macroalgae of the genus *Ericaria*

P105 Tamara Vujovic: Optimization of *Chlamydomonas reinhardtii* cultivation conditions: effects on growth performance

P106 Carlos Cardoso: Seasonality and geography as factors affecting lipid fraction and anti-inflammatory activity of the invasive seaweed *Rugulopteryx okamurae*

P107 María Gudjónsdóttir: Application of *Ascophyllum nodosum* processing side-stream in reduced-salt 3D printed surimi: effects on printability and functional properties

Session 2 – Processing technology and monitoring

P201 Tibor Jančí: Effects of chitosan concentration and rosemary extract level in edible coatings on the quality and shelf life of MAP-packaged sardines

P202 Andrew Couper: KTP Case Study: New England Seafood International & University of Lincoln Transforming Industrial Seafood Thawing Through Science-Led Innovation

Session 3 – Sustainability and resource efficiency

P301 Cheila Almeida: Boosting the environmental traceability of the Atlantic seafood sector – Sea to fork transparency and consumer engagement

P302 Kathrine Kjos Five: From chicken rest raw materials to aquafeed ingredients: production of protein hydrolysates and evaluation in Atlantic salmon feeding trials

P303 Clara M. Vásquez-Mejía: Environmental impacts on land-based salmon farming in Iceland

P304 Sæmundur Elíasson: Is renewing Icelandic demersal trawling vessels resulting in lower greenhouse gas emissions

Session 4 – Side stream utilisation

P401 Brede Bjerke Eiken: Bioprospecting and valorization of Atlantic cod (*Gadus morhua*) heads from the Norwegian seagoing fleet

P402 Isabel Fernández Segovia: Using sea bream by-products to produce new crackers: A sustainable approach for human nutrition

P403 Adrián Honrado Frías: Turning a Defect into Value: Antioxidant and Antimicrobial Potential of Muscle Hydrolysates and Exoskeleton Melanins from Melanosis-Affected Shrimp

P404 Marcin Rakowski: Consumer acceptance of food upcycling: cross-country insights from the Up4Food CAWI survey

Session 5 – Nutrition and consumer insights

P501 M.E. López-Caballero: Effects of an Octopus-Based Diet With or Without Tea Supplementation on Serum Biochemical Parameters in Mice

Session 6 – Underutilised species

P601 Carlos Cardoso: Seasonal and Spatial Variation in the Biotechnological Potential of the Gastropod *Vermetus triquetrus*

P602 Narcisa M. Bandarra: Biodiversity Conservation, Nature Restoration, and Resource Valorisation Through Knowledge: The Portuguese Marine BioBank

Session 7 – Quality and safety of aquatic products

P701 Despoina Kokioumi: Intelligent Platform for Cold-Chain Management. Shelf-life Prediction by Modeling Microbial Growth of Chilled Stored Sea Bream Fillets

P702 Stavroula Letsiou: Chitosan-based Antimicrobial Edible Coatings Affect Microbiota Profile and Extend Shelf-Life of Chill-Stored Sea Bream Fillets

P703 Iva Čanak: Effect of Rosemary Water Extract and Chitosan on the Microbiological and Biochemical Stability of Gilthead Seabream (*Sparus aurata*) Fillets under MAP storage

P704 Josip Čurko: Gaseous versus aqueous ozone pretreatments for extending shelf life and preserving the quality of fresh sardines

P705 Isabel Fernández Segovia: Influence of dietary thymol on the quality attributes of white shrimp (*Penaeus vannamei*)

P706 Michaela Schafberg: Enhancing Safety and Shelf Life of Cold-Smoked Salmon through Biological Preservation: The SLOPE Project

P707 Antonio Starcevic: Uncovering a Hybrid Epigenetic Defense Architecture in Myxozoan Parasites: Eukaryotic Guidance of a Horizontally Acquired Bacterial Weapon

P708 Natalija Topić Popović: Bacterial Communities Linked to Fish and Fishing Vessel Gear: Food Safety Considerations

P709 Agata Witczak: Effect of Whole-Fish Marination on the Transfer of PCDD/Fs, PCBs and PFAS from Viscera to Muscle in Baltic Sprat (*Sprattus sprattus*)

KEYNOTES

Algae and the Challenges for Food

Johan Robb Robbens

Flanders Research Institute for Agriculture, Fisheries and Food (ILVO)

Abstract

Algae are attracting increasing interest as ingredients for future foods. They offer a diversity of proteins, lipids and other valuable compounds, while some species provide marine flavours that are difficult to obtain from other non-animal sources. Yet the path from promising biomass to food that people want to eat is far from straightforward. Algal species differ greatly in composition, aroma and taste, and every step from cultivation to storage can affect the qualities of the final product.

The opportunities and challenges of bringing algae into food can be explored with flavour as a connecting theme. Chemical analysis and sensory evaluation can help identify suitable species, explain desirable and undesirable flavour notes, and guide ingredient and product development.

Species selection, cultivation conditions and processing offer ways to shape algal ingredients, but also involve trade-offs between nutritional value, technical performance and sensory appeal. Harvesting and storage can introduce further changes in flavour. Ultimately, the value of an algal ingredient must be assessed in the food in which it is used: an appealing flavour in the biomass does not necessarily translate into an appealing product. Food safety must be assessed throughout the production chain, and developers need to understand the regulatory status and requirements of each ingredient, including novel food rules where applicable.

For algae to move beyond niche applications, food development must connect their biological potential with the needs of producers and the expectations of consumers. Understanding how flavour develops and changes along the production chain can help turn promising algal biomass into foods that people choose to eat.

Dr. Johan Robbens has a background in biotechnology, molecular biology and marine biology. He holds a PhD in Molecular Biology from Ghent University and has developed extensive expertise in genomics, proteomics and (eco)toxicology. He also completed an MBA and additional programmes in management and intellectual property.

At ILVO-Marine, he leads the Marine Biotechnology and Food Integrity unit. His work connects the cultivation, analysis and processing of algae with their potential applications:

- Algae for food and feed: investigating microalgae and seaweeds as sources of proteins and other valuable compounds, with particular attention to flavour, food quality and consumer acceptance.



- Marine biotechnology: exploring bioactive compounds from algae and the valorisation of marine resources and side streams, including chitin from marine by-products.
- Food safety and biosensors: developing approaches for the rapid detection of contaminants, bacteria and other potential hazards.

He coordinates interdisciplinary research projects and works with academic and industry partners to translate findings into practical applications. Since 2025, he has also been a member of the Scientific Committee of the Belgian Federal Agency for the Safety of the Food Chain (FASFC).

Processing pelagic fish for consumers – From feed to food

Hildur Inga Sveinsdóttir

Matís Food and Biotech R&D

University of Iceland, Faculty of Food Science and Nutrition

Abstract

Small pelagic fish are abundant but often underutilised, with much of the catch directed towards fishmeal and fish oil rather than food. Increasing their use for human consumption requires attention to the entire value chain, from handling and processing to product development and consumer acceptance. In Iceland, research has focused largely on the processing and valorisation of Atlantic mackerel (*Scomber scombrus*) and Atlantic herring (*Clupea harengus*). More recently, Blue whiting (*Micromesistius poutassou*) has emerged as another species with both potential and practical challenges.

For blue whiting, maintaining quality begins at sea. Chilling methods can affect product composition, while long transport times, small size and soft flesh complicate quality preservation, mechanical handling and processing. An integrated approach is therefore needed, with handling, chilling, transport and processing adapted to the species.

Further along the value chain, storage and processing shape product quality. Product development, including mince-based products, can translate the characteristics of small pelagic species into familiar food formats. Consumer acceptance is also essential, as familiarity, perceived suitability and product presentation influence willingness to try less familiar species. Understanding these factors can guide product development and communication of the value of pelagic fish as food. Broader utilisation depends on maintaining quality throughout the value chain, developing products suited to the raw material and responding to consumer expectations. This offers opportunities to diversify seafood products and direct more pelagic catches towards human consumption.

Dr Hildur Inga Sveinsdóttir has a background in food science, seafood processing and marine bioresources. She holds a PhD in Food Science from the University of Iceland, where her research focused on adding value to Atlantic mackerel through improved processing and quality preservation.

She is a project manager at Matís and an associate professor at the University of Iceland's Faculty of Food Science and Nutrition. She also heads the Quality line within the UNESCO GRÓ Fisheries Training Programme and leads Iceland's Risk Assessment Committee for Food, Feed, Fertilisers and Seeds. Her research examines how handling, chilling, freezing, smoking and other processing operations affect seafood quality, stability and composition. It, further, focuses on creating higher-value uses for underutilised species, aquaculture materials and side streams from fish and seaweed processing. Through collaborative projects with academic and industry partners, she aims to take part in translating scientific findings into practical solutions for the food and seafood sectors.



Blue Food Futures: How Innovation, Circularity, and Smart Resource Use Can Build a More Resilient and Sustainable Food Industry

Sveinn Margeirsson

Director of Innovation and Climate Change at Brim



Abstract

Sveinn Margeirsson is Director of Innovation and Climate Change at Brim, one of Iceland's leading seafood companies and former CEO of Mátis. He has broad experience across science, industry, public administration and innovation, including senior roles in research and the seafood sector as well as serving as a municipal manager in Mývatnssveit. Sveinn holds a PhD in Industrial Engineering from the University of Iceland. His doctoral research, Processing forecast of cod, focused on decision-making in the cod industry based on the recording and analysis of value-chain data. The work used data from Icelandic cod fisheries and processing to develop statistical and optimisation models supporting better decisions on harvesting and processing. The results showed how factors such as fishing area, season, fillet yield, gaping and parasites influence value creation in the cod value chain. Throughout his career, he has worked at the intersection of knowledge, technology, sustainability and value creation, with a particular focus on turning research and innovation into practical solutions.

His current work at Brim centres on innovation, climate action, resource efficiency and long-term resilience across the seafood value chain.

As global demand for nutritious and sustainably produced food grows, the blue food sector faces both major opportunities and increasingly complex challenges. This presentation explores how innovation, circular approaches and smarter use of resources can strengthen competitiveness while improving environmental performance and resilience.

Drawing on experience from the seafood sector and from working across research, business and public administration, the presentation focuses on moving knowledge into practice. It highlights the importance of long-term investment, data and knowledge-driven decision-making, collaboration across the value chain, and making better use of available resources. The central message is that lasting progress depends less on short-term fixes and more on a strategic perspective that connects economic value creation, environmental responsibility and societal needs.

ABSTRACTS

F101 - Food Safety of Edible Seaweeds: Characterization of the Bacterial Flora Associated with Macroalgae from Northern France

Amelie Heliot¹, Anne Guichard¹, Maëlle Robert¹, Florianne Tranchevent¹, François Gevaert²

¹ Anses, Food Safety Laboratory, Sanaqua Unit, 6 boulevard du bassin, 62200 Boulogne-sur-Mer, France

² Université de Lille - UMR 8187 LOG

The development of the edible seaweed sector in France is accompanied by increasing food safety challenges. Macroalgae naturally harbor diverse bacterial communities whose composition is influenced by both algal species and environmental conditions. While some of these bacteria contribute to the functioning of the algal holobiont, others may include species of sanitary concern, highlighting the need for a better understanding of the microbial communities associated with seaweeds intended for human consumption.

In this context, this study aimed to characterize the bacterial communities associated with three edible macroalgal species collected along the northern French coast and to provide initial insights contributing to improved food safety assessment.

Samples of *Ulva* spp., *Saccharina latissima*, and *Palmaria palmata* were analyzed using a combined culture-based and molecular approach. Cultivable bacteria were isolated on selective and non-selective culture media and identified by MALDI-TOF mass spectrometry. In parallel, the overall bacterial community was characterized by high-throughput sequencing of the 16S rRNA gene to complement culture-based analyses. Several post-harvest washing procedures were also evaluated to assess their effect on reducing the bacterial load of seaweeds.

Preliminary results revealed abundant and diverse bacterial communities whose composition differed among macroalgal species. Culture-based analyses identified numerous bacterial genera belonging to the natural seaweed microbiota, together with genera that include species of food safety interest. Post-harvest washing resulted in a marked reduction of the bacterial load, highlighting the potential of simple processing practices to improve the microbiological quality of edible seaweeds. Ongoing 16S rRNA sequencing analyses will provide a more comprehensive description of bacterial diversity and help evaluate the impact of washing treatments on community structure.

This study provides new insights into the bacterial communities associated with major edible macroalgae harvested along the northern French coast. It represents a first step toward the development of microbiological surveillance tools and strategies aimed at strengthening the food safety of edible seaweeds while supporting the sustainable development of this emerging sector.

F102 - Development of high value food grade sugar kelp (*Saccharina latissima*) production in Northern Norway

Hanne K. Mæhre¹, Dominykas Salvaitis¹, Christian G. Bruckner²

¹ NIBIO, Bodo, Norway

² Polaralge AS

Background/Aim of study: Quality grading of sugar kelp in Asia relies on specific quality parameters, such as colour, texture and thickness, umami, surface powder and cleanliness. High quality Asian sugar kelp is normally 3-4 meters long and more than 1 meter wide. At present, sugar kelp cultivated in Norway rarely exceeds 1 meter in length due to the simple cultivation techniques used and will thus not be regarded as high quality in Asian markets, even if the nutritional quality has proven to be good. The main aim of this study was to produce sugar kelp in Northern Norway that can compete on an international market, by implementing Asian cultivation techniques.

Material/methods/design: Sugar kelp sporophytes of 15 to 30 cm were manually fixed on ropes with up to 50 cm between individuals and deployed to sea when the algae had firmly attached to the ropes. Growth was monitored during the production, and the algae was thinned out to maximise available space and light conditions. Sugar kelp cultivated at the same time and location using the classical Norwegian procedure was used as a reference. After harvesting, wet weight and length were measured, and biochemical analyses were performed to determine nutritional quality.

Results and discussion: Individuals cultivated by the Asian method were longer, wider and thicker than the ones cultivated by the Norwegian method. The Asian algae were freeze-dried as individuals ($n = 11$) while the Norwegian algae were pooled to obtain a similar sample size ($n(\text{pooled}) = 11$). Dry matter and hydrolysable fibre contents were higher in the Asian algae than in the Norwegian algae, while ash content was significantly higher in the Norwegian ones. Lipid and protein contents were similar. Amino acids related to umami taste, mainly aspartic and glutamic acid, were slightly higher in the Norwegian algae than in the Asian ones. The glucose content responsible for sweet taste was significantly higher in the Asian algae than in the Norwegian algae.

Conclusions: This project has shown that producing sugar kelp of a size that is considered as high value food grade quality on the Asian market is achievable in Northern Norway by implementing the Asian cultivation method. The results from this study may be a contribution to develop Norwegian algae industry further.

F103 - Effects of dietary microalgae on fillet quality and nutritional composition of farmed Atlantic salmon

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Aim of research: The growth of aquaculture has intensified the need for sustainable feed ingredients, and the share of marine raw materials in salmon feed has fallen from about 90% in the 1990s to roughly 22% today. Locally cultivated microalgae are a promising marine alternative. Within the Mikrofôr project, this study evaluated how graded dietary inclusion of the cold-water diatom *Porosira glacialis* affects fillet quality and nutritional composition of farmed Atlantic salmon (*Salmo salar*), to assess its suitability as a novel feed ingredient.

Material, methods and design: Atlantic salmon smolt were fed standard diets containing 0, 5 or 10% spray-dried *P. glacialis* biomass (three tanks per diet) from about 100 g to 750 g over six months at the Tromsø aquaculture research station. At harvest, fish were sampled for biochemical composition (n=6 per diet: water, ash, protein/amino acids, lipid/fatty acids, metals and minerals) and for fillet quality (n=12 per diet: industry firmness test, instrumental texture profile analysis, colour by SalmoFan, colorimetry and machine vision, drip loss and water-holding capacity), assessed three days post-slaughter. Differences were tested by ANOVA (p<0.05).

Results and discussion: Fillet weight and length did not differ significantly between diets. At the final sampling the proximate composition showed minor differences: the 5% group had significantly higher fat (13.4%) and higher EPA and DHA than the 0% (10.9%) and 10% (11.5%) groups, whereas protein was highest in the control; total n-3 LC-PUFA (10–13%) did not differ significantly. Iodine was higher in 10% fillets than in the control and iron was slightly elevated, while toxic metals (Cd, Hg, Pb) remained very low. Sensory judges perceived control fillets as softer and less springy, and instrumental texture indicated a tendency towards firmer, more resilient fillets with algae inclusion. Fillets from the 10% diet were perceived as paler and less red, supported by machine-vision ranking, whereas SalmoFan and colorimetry showed no significant colour differences. Drip loss tended to be marginally higher with algae, and water-holding capacity was high (96–97%) across diets. No taste or odour differences were detected.

Conclusions: Graded inclusion of *P. glacialis* up to 10% caused only minor effects on salmon fillet quality and nutritional composition, supporting its use as a sustainable, locally produced feed ingredient. At the highest inclusion, paler colour, altered texture and elevated iodine warrant attention when formulating diets, although iodine enrichment may also offer nutritional benefits for consumers.

S101 - Scalable biofortification of *Nannochloropsis oceanica* with vitamin D₃ using UV-induced conversion

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The increasing demand for sustainable, nutrient-dense ingredients for both food and feed applications has intensified interest in microalgae as alternative sources of essential nutrients, including long-chain polyunsaturated fatty acids such as eicosapentaenoic acid (EPA) and vitamin D₃ (cholecalciferol). In this study, we present a scalable strategy for biofortifying *Nannochloropsis oceanica* with vitamin D₃ through UVC-induced conversion.

A pilot-scale system was developed, integrating continuous-flow UVC treatment (Raslysat, LYRAS) to convert endogenous sterol precursors, primarily 7-dehydrocholesterol, into vitamin D₃. This setup enables controlled and uniform irradiation of algal biomass under industrially relevant conditions, addressing key challenges related to process scalability and dose distribution. Process parameters—such as UVC intensity, exposure time, and cell density—were systematically investigated to optimize vitamin D₃ conversion while preserving biomass quality, with particular emphasis on maintaining EPA levels.

The results demonstrate that UVC-based treatment can effectively enhance vitamin D₃ content in *N. oceanica* without compromising its value as a source of omega-3 fatty acids. The balance between conversion efficiency and preservation of sensitive compounds was found to be highly dependent on process conditions, highlighting the importance of precise control during scale-up.

This study confirms the feasibility of integrating UV-driven biofortification into microalgae production systems and identifies key parameters for process optimization. The approach provides a promising pathway to producing vitamin D₃-enriched algal biomass for food and feed applications, supporting more sustainable production of essential nutrients.

This work is part of the mission-driven research project AlgaeVita, funded by AgriFoodTure and Innovation Fund Denmark. Partners in the project: Herbaceum, LYRAS A/S and DTU National Food Institute.

S102 - Development of food prototypes containing seaweed

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Climate change, population growth, and diet-related diseases are putting pressure on global food systems, while several food resources are used inefficiently. Seaweed offers a promising solution as a nutrient-rich, fast-growing food source that requires no land, freshwater, or fertilizers, supporting healthier and more sustainable diets. Within the SEAFOODUTRE project, the main aim of this study was to develop high nutritional quality short shelf-life food prototypes containing seaweed.

The development of the food prototypes started as a broad process, with ongoing adjustments based on input from a consumer study and insights from different seaweed processing methods explored within the SEAFOODTURE project. The stages of food product development included 1) initial scoping and evaluation of raw material, seaweed species and threshold values, 2) an iterative development phase including fine tuning of recipes informed by findings from the consumer study and complementary work on protein extraction and digestibility analyses of different species. Several experiments were carried out to refine the recipes, with each iteration progressively optimising the prototypes toward their final form, 3) a joint experiment with sensorial testing of the food prototypes.

In the early stage of the project, fish products showed higher potential than meat products. Based on insights from the consumer study, three products were selected for further testing to see how seaweed could be incorporated: rice balls, salmon burgers, and fish cakes made with white lean fish. Several seaweed species were explored in the initial trials, but both the type and the amount added were refined as new results emerged. Ultimately, *Ulva* and *Porphyra* were selected for further work. Taste evaluations identified rice balls as the most promising product. As a result, the joint experiment focused mainly on dried *Porphyra* and *Ulva*.

After an iterative process of formulation screening, consumer-informed selection criteria, and processing optimisation, a promising food prototype containing seaweed was established. The rice ball prototype containing *Porphyra* and *Ulva* demonstrated suitable technological performance, good reproducibility, and product stability.

F104 - From Product Development to Market Adoption: Lessons for Go-to-Market Strategies

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Aim of research: The European algae industry has invested heavily in developing novel ingredients and materials, yet relatively few products have reached the market. While technical development often receives considerable attention, less is known about which factors are most important when moving algae-based innovations from pilot scale towards commercial adoption. This study examines the development and validation of go-to-market (GTM) strategies for algae-derived products developed in the Horizon Europe projects SeaMark and AlgaeProBANOS, and identifies key success factors and remaining barriers for market entry.

Material/methods/design: The study is based on GTM strategies developed for 12 algae-based products targeting the pet food, nutraceutical, cosmetic, food, and packaging sectors. Data were collected through structured surveys and follow-up interviews with industrial partners responsible for commercialization activities. The analysis draws on customer testing, pilot-scale deliveries, early commercial sales, and comparisons between initial, updated, and final GTM strategies. Particular attention was given to how customer feedback influenced strategic decisions and market positioning.

Results and discussion: The findings show that GTM strategies evolve considerably during product development. Initial strategies were generally broad and technology-driven, whereas later versions became more market-focused and product-specific. Across sectors, sustainability was consistently regarded as a strength. However, sustainability alone was not sufficient to drive commercial interest. Customers typically require additional value propositions linked to functionality, performance, or documented efficacy.

Scientific validation emerged as one of the most important factors affecting market readiness. Products supported by clinical, in vitro, or application-specific performance data received the strongest customer interest. Regulatory readiness and certification requirements also played a decisive role. In cosmetics, certifications such as COSMOS or NATRUE were frequently identified as prerequisites for market uptake, while novel food approval remained a key challenge for some food and nutraceutical applications.

Customer testing further revealed that different product attributes, including colour, odour, and ease of formulation, could significantly influence adoption decisions.

Conclusions: The study demonstrates that effective GTM strategies for algae-based products require more than technical innovation and sustainability claims. Market adoption depends on a combination of customer validation, scientifically documented benefits, regulatory preparedness, and product characteristics that fit market expectations. Early interaction with customers and continuous refinement of GTM strategies appear essential for reducing commercialisation risk and improving the likelihood of successful market entry for novel algae products.

F105 - Improving Seafood Confidence Among Young Norwegian Consumers: Effects of Digital Literacy Interventions and Raw Material Transparency on Perceptions of Seafood Value

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Increasing seafood consumption among young adults remains a challenge, despite widespread awareness of seafood's nutritional and sustainability benefits. However, previous research identifies affordability and low food literacy as key barriers to seafood consumption among younger consumers. The expensive cost of seafood and the belief that it is difficult to prepare can lead consumers to fear wasting money if they handle or cook it incorrectly. Moreover, Norwegian seafood consumption mainly focuses on fillets, with edible co-products like skin and other fish parts rarely used. Since fillets are the most valuable part of the fish, this focus might restrict the use of more cost-effective seafood options. Additionally, young consumers tend to have less confidence in selecting, handling, and preparing these alternative seafood products, which can slow their acceptance.

This study examines whether targeted digital communication can enhance consumer perception and intention regarding seafood as a cost-effective food source, especially when considering alternative seafood options. A pre-post experimental design will be conducted among Norwegian consumers aged 18–35 years. Participants will first evaluate seafood products on a range of perception measures, including expected quality, perceived value, price fairness, and preparation confidence. Subsequently, participants will be assigned to an intervention condition involving exposure to a TikTok video presenting practical seafood purchasing strategies, including guidance on selecting whole fish, utilizing less familiar species, and making cost-effective seafood choices. Electroencephalography (EEG) measures will be employed to verify participant engagement and cognitive stimulation during exposure.

Following the intervention, participants will re-evaluate seafood products using the same measures. Participants will then evaluate a seafood snack product and report their willingness to consume the product, confidence in consumption, and perceived price. In the next stage, respondents will receive information revealing that the snack is produced from salmon skins together with visual depictions of the raw material. Eye-tracking data will be collected to assess visual attention to this information. Participants will subsequently re-evaluate the snack using the same measures.

Results are expected to provide novel insights into how digital educational content influences consumer perceptions of seafood quality, value, and consumption confidence. Findings will contribute to evidence-based marketing and public health strategies aimed at increasing seafood consumption among young Norwegian consumers and demonstrate the potential of combining behavioural measures with neurophysiological methods in seafood consumer research.

F106 - Microencapsulated natural seasoning blends as a strategy for sodium reduction in canned skipjack tuna: A 24-month storage stability study

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Given the need to reduce sodium intake, this work aimed to evaluate the effects of a 40% NaCl reduction and/or the incorporation of microencapsulated blends of aromatic plant and spice extracts on commercial stability, sterility, physicochemical and sensory properties, and overall liking of canned skipjack tuna (*Katsuwonus pelamis*) stored for up to two years at room temperature. Four canned tuna products in brine were prepared under industrial conditions (Cofisa, S.A.; ≈400 cans per formulation): i) CTR, the commercial formulation (business-as-usual); ii) RED, with a 40% NaCl reduction; and iii–iv) RED-S1 and RED-S3, each with a 40% NaCl reduction and formulated with a compositionally distinct microencapsulated blend of aromatic plant and spice extracts. Cans were aged for six months at 20 °C and 40 °C to simulate approximately two years of storage. Generally, neither formulation nor the ageing process significantly affected commercial stability, sterility, proximate composition, or most sensory attributes (assessed by a trained panel). Saltiness was perceived as higher in CTR, and no off-odours or off-flavours were detected in any formulation. Total volatile basic nitrogen contents increased during storage but remained below 33 mg/100 g in all formulations. Likewise, thiobarbituric acid reactive substances values were low (≤0.7 mg MDA/kg), indicating minimal lipid oxidation throughout storage. RED, RED-S1 and RED-S3 contained 0.5–0.7% NaCl (vs. ≈1.2% in CTR), corresponding to sodium reductions of approximately 40–64% and thereby meeting the requirements for the “reduced sodium content” claim (Regulation (EC) No 1924/2006). Formulation significantly influenced instrumental colour, particularly lightness and yellowness, whereas storage had a less pronounced effect. Texture and pH remained stable throughout storage, with RED-S3 exhibiting lower rupture force than the other formulations. Although RED-S1 and RED-S3, containing microencapsulated seasoning blends, received significantly lower overall liking scores than CTR and RED (corresponding to “like slightly” to “like moderately” versus “like moderately” to “like very much”), approximately 70–80% of consumers rated both products positively during storage. Overall, the results demonstrate that a 40% NaCl reduction, with or without the incorporation of microencapsulated blends of aromatic plant and spice extracts, can be successfully implemented in the industrial production of canned skipjack tuna without compromising commercial stability, product safety or quality throughout two years of storage. These microencapsulated blends represent a promising clean-label strategy for sodium reduction, although further optimisation of formulations is required to maximise consumer acceptance.

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F107 - Nutrition claims-oriented canned meals from sustainable marine resources

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Growing demand for nutritious, sustainable and convenient ready-to-eat foods is driving the development of innovative canned products formulated from sustainably marine resources. This study aimed to: i) Develop canned meals based on a targeted nutritional formulation strategy tailored to the dietary requirements of distinct population groups.

Two formulations were developed and scaled up using distinct sustainable marine resources: (i) Atlantic chub mackerel (*Scomber colias*), a nutrient-rich species sourced from sustainably managed fisheries, to develop a meal (ACM); and (ii) the brown seaweed *Himanthalia elongata*, a natural source of iodine and dietary fiber, to formulate a vegetarian meal (VM). ACM meal was formulated with chickpeas, carrots, and green beans in a tomato-based sauce, whereas the VM consisted of rehydrated seaweed, white beans, and carrots in an olive oil-based filling medium seasoned with herbs and spices. targeting different population groups (COFISA, S.A.).

Chemical composition of formulations was determined to verify compliance with the targeted nutritional claims and to assess quality and safety. Storage stability was evaluated under accelerated ageing conditions, and consumer acceptance was assessed through an accredited hedonic sensory evaluation.

Both formulations successfully fulfilled the defined targeted nutrition claims, namely: i) high in protein (>20% energy from protein) and low in fat (≤3 g/100 g); ii) ACM was qualified as a source of fibre (>3 g/100 kcal), high in n-3 fatty acids (>80 mg EPA+DHA/100 g and /100 kcal), reduced in salt (>25% less salt than the reference product), source of selenium (≥15% of the nutrient reference value (NRV)/100 g), high in molybdenum (≥30% of the NRV/100 g) and iii) VM was qualified as high in fibre (≥6 g/100 g) and high in iodine (≥30% of the NRV/ 100 g). Both products remained commercially sterile throughout storage. Moreover, concentration of toxic elements (Hg, Cd, Pb and As) remained below the regulatory limits. Regarding sensory quality, over 75% of responses of the hedonic test ranged from “like it moderately” to “like it extremely” for both meals.

The proposed formulations enabled the development of two canned meals from sustainable marine ingredients with complementary nutritional profiles. The combination of targeted nutrition claims, chemical safety, storage stability and overall liking demonstrates the potential of this approach to support the production of innovative shelf-stable, tailor-made and sustainable foods while promoting marine resources valorisation.

Funding: Blue Bioeconomy Innovation Pact (WP4) and Fundação para a Ciência e a Tecnologia, I.P.

F108 - Nutritional Quality of Fermented Fish Products from Baltic Herring (*Clupea harengus membras*)

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Aim of research: Our aim was to apply a short-term controlled fermentation (STCF) for producing new, tasty and healthy foods from Baltic herring (*Clupea harengus membras*). It has high nutritional value as it is rich in protein, unsaturated fatty acids, minerals, and vitamins. Still, it is nowadays underutilized as food in Finland. Fermentation is a food processing technology, which can be applied to enhance the nutritional value and flavour of foods, while also extending the shelf-life by inhibiting microbial growth and lipid oxidation. Traditional fermented fish products are typically high in salt, which contradicts with the dietary guidelines for healthy diets. Thus, new solutions are needed to enable production of healthy and tasty fish products also from the underutilized fish species.

Material and methods: A STCF with different lactic acid bacteria (LAB) starters was used on Baltic herring fillets. Prior to fermentation the frozen fillets were autoclaved in NaCl solution. Nutritional quality (proximate, amino acid, fatty acid compositions), salt concentrations, and the lipid oxidation level were analysed. Additionally, the sensory quality of the fermented Baltic herring samples was evaluated.

Results and discussion: The nutritional and sensory quality of the products varied between the starters applied. The results showed increased protein content and low salt content for the fermented fillets. In the sensory evaluation, a fresh and sufficient salty taste was reported for the fermented fillets. A moderate level of lipid oxidation was observed, indicating that LAB starters can inhibit lipid oxidation in Baltic herring fillets. The results indicate that the controlled fermentation process developed in the current study can be applied to produce new, tasty fish products with healthy nutritional composition and low salt contents.

Conclusion: Our study provides new evidence on the impact of STCF on the nutritional quality, shelf-life, and sensory quality of Baltic herring fillets, supporting the development of safe, tasty, and healthy fish products from Baltic herring.

F109 - Blue Bioeconomy-Driven Functional Protein Hydrolysates from *Clarias gariepinus*: Physicochemical Profile and Technological Potential for Food Applications

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The valorisation of fishery by-products and underutilised species is a priority within the blue bioeconomy because it enables the conversion of low-value biomass into functional ingredients with environmental and socio-economic benefits. This study evaluated protein hydrolysates from African catfish *Clarias gariepinus*, produced by enzymatic hydrolysis and compared the results with commercial tilapia and codfish hydrolysates.

The degree of hydrolysis (19.83–23.16%) was consistent with the generation of intermediate and low-length peptides. Proximate composition revealed high protein content (75.16–77.75%), low moisture (2.33–3.88%), ash (13.80–14.60%), and fat (1.78–5.24%), confirming the efficiency of the valorisation process and the hydrolysate suitability for industrial applications. Protein solubility of catfish hydrolysate was substantially higher than that of the commercial hydrolysates (81.4–92.9% vs 64.0% for tilapia and 67.6% for codfish), supporting its dispersibility in liquid formulations. Catfish hydrolysate exhibited greater water-holding capacity (3.40 mL/g) and fat absorption capacity (2.48 g/g) than commercial hydrolysates, and showed markedly superior foam stability, retaining 64.7% of the initial foam after 60 min, whereas tilapia and codfish commercial hydrolysates collapsed completely (0%). Emulsifying activity (3.73 m²/g) was lower than that of tilapia hydrolysate. The observed high hygroscopicity implies the need for moisture-barrier packaging when African catfish hydrolysate is dried.

Overall, *C. gariepinus* co-products emerge as a promising and technically robust source of protein hydrolysates, aligned with circular valorisation strategies and food innovation in Africa. From a technological perspective, the functional profile of catfish hydrolysate supports its use in emulsified meat products, where it may improve yield and juiciness; aerated systems, including mousses and protein beverages requiring stable foam; bakery products, where moisture retention may extend shelf life; and functional beverages, where high solubility is advantageous. Identified limitations include inter-batch variability, the need to control lipid-derived oxidation in batches with higher residual fat, and the absence of direct estimates of percentage yield improvement in industrial matrices.

Future work should address microencapsulation strategies, antioxidant stabilisation, and validation in food systems. It should also focus on the incorporation of catfish protein hydrolysates into biscuits followed by comprehensive sensory evaluation to assess consumer acceptability and functional performance.

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F110 - Tunicates as a novel feed ingredient for Atlantic salmon

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Aim of research: The main objective of the Ciona project is to establish the necessary knowledge base for using tunicates as a commercial raw material in salmon feed.

Several reports have assessed the potential of various novel raw materials as bulk ingredients in fish feed for Atlantic salmon. In several of these, tunicates, or sea squirts, have stood out as a raw material that can meet requirements for volume, nutritional composition, and environmental sustainability. Tunicates are a group of invertebrates consisting of an inner animal surrounded by a mantle, or tunic. They contain both marine proteins and omega-3 fatty acids, which are important nutrients for salmon, and the tunic is also rich in cellulose, which may have other, higher-value applications.

Results: Tunicates have a high-water content, and after drying, a relatively high ash content. To produce high quality feed ingredients from this biomass, efficient harvesting and processing methods need to be developed. Results from fractionation of tunicates will be presented, reporting nutritional composition of different parts of the tunicate. The digestibility of produced tunicate meal was evaluated in a feeding trial with Atlantic salmon, at an inclusion level of 20 %. Based on the results, a longer growth trial will be carried out to examine growth, product quality, and fish health when fed diets including selected tunicate.

Conclusion: Results from the Ciona project will directly assist in prioritizing which feed raw materials should be targeted for the future and provide important insight into the future potential of low-trophic raw material production.

S113 - Catch Damage and Quality Defects Associated with Different Fishing Gear in the Norwegian Cod Fishery

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Material/methods/design: Catch-damage assessments were conducted at fixed landing sites in Northern Norway using a standardized catch damage index. In 2025, 4,400 cod from 88 commercial catches were examined including fish caught by gillnet, demersal seine, longline, and handline/jigging. Individual fish were scored for quality defects, including fish dead in gear, poor bleeding, blood spots, gear marks, hook damage, crush injuries, skin abrasion, and internal haemorrhaging related to swim bladder rupture. Fish were subsequently classified as good, reduced, or poor quality. Results from 2025 were compared with data from 2014 and mean values from 2015–2024.

Results and discussion: In 2025, 94% of longline-caught cod and 99% of handline-caught cod were classified as good quality. Demersal seine catches contained 78% good-quality fish, whereas gillnet catches had the lowest quality, with only 22% classified as good quality. However, the proportion of poor-quality fish in gillnet catches was substantially lower than in previous years.

The most important quality defects were fish dead in gear, poor bleeding, blood spots, crush injuries, and internal haemorrhaging. Fish dead in gear remained the most serious defect and was particularly prevalent in gillnet fisheries. Poor bleeding affected the largest proportion of fish across all gears and was a major cause of quality reduction. Internal haemorrhaging associated with swim bladder rupture was especially common in large demersal seine-caught cod and may reduce suitability for saltfish production.

Overall cod quality remained relatively stable during 2014–2025, although substantial differences were observed among fishing gears. Results from 2025 were among the best since the monitoring program started.

Conclusions: Fishing gear and capture practices strongly influences cod quality at landing. Longline and handline consistently produced the highest-quality raw material, whereas gillnets and demersal seines resulted in greater catch-related damage and reduced quality. Although quality in 2025 was among the best recorded, further improvements are possible through reducing stress and mortality in gear, improving bleeding and avoiding mechanical injuries.

F114 - Valorisation of chub mackerel: seasonal lipid composition and ready-to-eat product

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Aim Research: Chub mackerel (*Scomber colias*) is an abundant pelagic species along the Portuguese coast, but it remains an underutilized marine resource despite being an excellent source of the health-promoting omega-3 polyunsaturated fatty acids (n-3 PUFA), particularly docosahexaenoic acid (DHA, 22:6n-3) and eicosapentaenoic acid (EPA, 20:5n-3). This study proposes a double objective: (i) characterisation of the seasonal variation of lipid fraction of chub mackerel as well as (ii) development and chemical characterisation of a healthy, nutritious and ready-to-eat chub mackerel meatballs.

Material/methods/design: The chub mackerel lipid fraction was characterised during 12 consecutive months in terms of total lipids (Bligh and Dyer method) and fatty acid profile (GC-FID). The novel ready-to-eat seafood, in turn, was analysed in terms of proximate composition (moisture, protein, ash carbohydrates and total lipids) and its fatty acid profile.

Results and discussion: As expected marked seasonal differences were observed in chub mackerel lipid content, ranging from 1.3 to 10.3 g/100 g of edible part. The lowest lipid content occurred during the spawning season (February), while the highest was recorded in September. PUFA were the predominant FA group throughout the year, reaching the highest relative abundance during winter (60.9–66.9%), whereas saturated fatty acids (SFA) led between March and August (25.3–32.3%). The highest n-3 PUFA absolute content was found in September (4834.6 mg/100 g wet weight), including 2473.8 mg/100 g DHA and 1534.5 mg/100 g EPA. To promote its valorisation, ready-to-eat chub mackerel meatballs were developed as a convenient seafood product requiring less than one minute of microwave heating before consumption. The final product showed a balanced nutritional composition, with 70.36 g/100 g moisture, 14.86 g/100 g protein, 4.82 g/100 g lipids, 8.45 g/100 g carbohydrates, and 1.51 g/100 g ash. The lipid fraction maintained a favourable dietetic profile, with n-3 PUFA accounting for 8.3% of total fatty acids, including 5.9% DHA.

Conclusion(s): These results show that, depending on the season, the consumption of 12 g of chub mackerel may be enough to cover the recommended daily dose of 500 mg/day of EPA and DHA, confirming the high nutritional value of this species.

The successful incorporation of chub mackerel into a convenient, nutritious ready-to-eat seafood product, such as ready-to-eat chub mackerel meatballs, demonstrates the potential of this underutilised species to promote seafood consumption, support healthier dietary patterns, and contribute to the sustainable upgrading of sustainable pelagic fish resources.

F201 - From sub-chilling to tempered thawing: How cold-chain protocols shape quality in Atlantic salmon (*Salmo salar* L.)

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Introduction: Reducing the climate impact of Norwegian salmon exports requires shifting from airfreighted fresh products to frozen fillets shipped by sea. However, consumer acceptance depends on achieving frozen-thawed quality comparable to fresh salmon. This study systematically evaluated how pre-freezing treatment, freezing rate, frozen storage conditions, and thawing strategy influence physicochemical quality and post-thaw stability of Atlantic salmon fillets.

Materials and methods: A full factorial 2⁴ design was used to test 16 protocol combinations, plus the fresh baseline. The factors included were: pre-freezing treatment (ice-chilled + conventional freezing vs sub-chilled + dry ice freezing), storage temperature (-18°C vs -40°C), storage duration (2 vs 14 weeks frozen storage), and thawing method (direct vs two-step tempering (-18/-40°C → -12°C, → -7°C)). Fillets (n = 216) were analyzed at days 1, 5, 12, and 16 post thaw for drip loss, water holding capacity (WHC), pH, texture, colour, and dry matter. The fresh baselines were analyzed following the same schedule.

Results: Sub-chilling combined with rapid dry-ice freezing significantly reduced drip loss compared with ice-chilled + conventional freezing (3.4% vs 4.5%; p < 0.001). Storage at -40°C improved WHC and reduced drip loss compared with -18°C (p < 0.001). Tempered thawing reduced drip loss compared with direct thawing (p = 0.001). Storage duration affected pH and colour but not drip loss.

Across all treatments, drip loss increased steadily during post-thaw storage (from 2.5% on Day 1 to 4.9% on Day 16; p < 0.001), while WHC increased over time, indicating structural changes during chilled storage. Colour parameters (a, b, C*) decreased with prolonged frozen storage and during post-thaw storage. Texture softened significantly over time in fresh and frozen thawed fillets.

A key interaction (p < 0.001) showed that ice-chilled fillets were highly sensitive to storage temperature, with markedly higher drip loss at -18°C, whereas sub-chilled fillets remained stable across temperatures.

Conclusion: The optimized protocol combining sub-chilling, rapid dry ice freezing, ultra-low storage temperature (-40°C), and tempered thawing consistently improved water retention, colour stability, and overall quality. While the frozen-thawed fillets did not fully match fresh quality, the best protocol combinations substantially narrowed the gap. The results demonstrate that high-quality frozen thawed salmon is achievable when cold chain parameters are optimized across all stages, supporting the feasibility of low emission frozen export pathways.

F202 - Industrial Non-Destructive Spectroscopy for Assessing Seasonal Texture-Related Physicochemical Properties of Atlantic Cod (*Gadus morhua* L.) Fillets

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The aim of the present study was to develop non-destructive methods for measuring physicochemical parameters related to the texture of Atlantic cod fillets at two points during the fishing season. The methods were based on spectroscopy and included hyperspectral imaging (HSI) and a handheld NIR spectrometer. Hyperspectral images were acquired using the commercially available Maritech Eye™ HSI system. Operating with interactance lighting at an industrial scanning speed of 0.45 m/s, the system captures 88 spectral bands within the visible-to-near-infrared range (493–945 nm), scanning line by line as the sample moves through the camera's field of view. The handheld spectrometer captures a single spectral signal at the measurement point and records 125 bands in the NIR spectral range of 908–1676 nm.

A total of 147 Atlantic cod samples were collected onboard commercial trawlers operating in the Norwegian Sea and Barents Sea in February and October 2025. Weight, condition, and handheld spectroscopic measurements were obtained for each fish onboard the vessel. The fish were then filleted and stored on ice until landing. On land, the fillets were imaged using HSI, followed by measurements of texture using a compression test, water-holding capacity (WHC), final pH, and total amino acid content from the loin portion of the fillet.

The mean total amino acid content differed by approximately 5 percentage points between seasons, with the February samples containing $15.75 \pm 0.80\%$ and the October samples containing $20.75 \pm 1.8\%$. The fillet loin was also 12% firmer in February than in October, while WHC increased by 3.78% in October.

The data were split into training (80%) and test (20%) sets, and partial least squares regression (PLSR) models were developed to predict the physicochemical parameters. Prediction of total amino acid content produced the most robust results using Savitzky–Golay smoothing and the first derivative on the HSI spectrums. The HSI model achieved a coefficient of determination (R^2) of 0.91 during cross-validation and 0.85 for the independent test set, with root mean square errors of 1.08 and 0.96, respectively. The spectral features of Atlantic cod muscle acquired by HSI were dominated by the absorption of haem pigments at shorter wavelengths and water absorption at longer wavelengths. Despite this, the PLSR model for total amino acid prediction showed little sensitivity to elevated blood concentrations. Future work will investigate collagen cross-linking amino acids, their relationship to texture, and prediction using spectral data.

F203 - The hidden weight of water in commercial cod catches

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Aim of Research: Accurate determination of catch weight is important for fishers' earnings, processors' operating margins, and the sustainable management of marine resources. To maintain quality, cod is commonly stored and transported in cold water both on board fishing vessels and at processing plants. Consequently, water may accompany the fish through purchasing and weighing systems and contribute to the recorded weight. This study aims to quantify the amount of water associated with fish during commercial weighing and purchasing operations.

Material/Methods/Design: Several purchasing lines were initially mapped and assessed, after which three lines with different designs were selected for trials. A drainage grid was crafted to drain large volumes of fish, and experiments were conducted to evaluate water drainage and determine an appropriate drainage period. Batches of intact and gutted Atlantic cod (*Gadus morhua*) were collected directly from the purchasing scale into a tared container. The containers were weighed before and after drainage to quantify the amount of water associated with the fish.

Results and Discussion: Preliminary results indicate that almost 2% of the weight passing through the weighing system may consist of water. Furthermore, the design of the purchasing line appears to strongly influence the amount of water retained and carried through the scale. Gutted cod carried more water than intact fish; nevertheless, even whole cod were associated with more than 1% excess water by weight. These findings may explain observations from fish buyers who have reported discrepancies between the quantity of fish purchased and the quantity ultimately processed. Given current cod prices and the large volumes handled by commercial fish landing facilities, water retained in the weighing process may represent a considerable economic loss.

Conclusions: The trials suggest that a measurable proportion of the weight recorded in fish purchasing systems may consist of water rather than fish biomass. The amount of water associated with the fish appears to be influenced by both fish condition (intact versus gutted) and purchasing/processing-line design. While additional trials are needed to validate and strengthen these findings, the study provides new documentation on the contribution of transport water to recorded fish weight. This knowledge may be relevant for industry stakeholders and regulatory authorities in future assessments of weighing and registration practices.

F204 - Robust Prediction of Remaining Shelf Life in Cod Fillets Using Hyperspectral Imaging and Machine Learning

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Aim of research: The aim of the study was to develop and evaluate a robust hyperspectral imaging (HSI) approach for estimating the remaining shelf life of Atlantic cod (*Gadus morhua*) fillets. Sensory shelf-life assessments were used as the reference method, and particular emphasis was placed on model robustness, generalizability, and biological interpretability.

Materials, methods, design: A neural-network-based regression model was developed to predict remaining shelf life directly from hyperspectral images of cod fillets. Model performance and robustness were assessed using a leave-one-experiment-out validation strategy. To improve interpretability, partial dependence analyses were performed to identify stable spectral regions associated with shelf-life progression. Alternative methods for aggregating pixel-level predictions into fillet-level estimates were evaluated, and spatial prediction patterns within fillets were investigated. These patterns were further compared with spatially resolved NMR measurements of trimethylamine (TMA) and trimethylamine N-oxide (TMAO).

Results and discussion: The developed model demonstrated promising predictive performance and maintained good generalization across independent storage experiments. Partial dependence analyses indicated that the model relied on stable and biologically meaningful spectral features after exclusion of wavelengths below 620 nm. Spatial prediction maps revealed heterogeneous shelf-life estimates within individual fillets, despite training on fillet-level sensory labels only. The spatial patterns were consistent with independent observations from spectral analyses and NMR-derived TMA/TMAO distributions, suggesting that the model captured underlying biological variation in quality degradation. The model also correctly assigned shorter remaining shelf life to fillets subjected to elevated pre-filleting storage temperatures. Validation experiments showed good agreement between model predictions and sensory assessments and demonstrated the ability to detect quality differences related capture method and fish condition.

Conclusions: The results demonstrate that hyperspectral imaging provides robust and relevant information for estimating remaining shelf life of cod fillets. The approach showed good predictive performance, robustness when applied to new data, and consistency with known biochemical processes associated with quality deterioration. The ability to identify quality differences immediately after filleting and to capture effects of handling and storage conditions strengthens potential for industrial implementation. Based on rapid and non-destructive technology, the developed method may support objective quality assessment, shelf-life prediction, and decision-making in fish processing operations. Future work should focus on integrating spatially resolved chemical, spectral, and sensory data to reduce reference uncertainty and further improve prediction accuracy.

F205 - Impact of Processing Technologies on the Quality and Storage Stability of Texture-Modified Salmon Products

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Aim of research: Texture-modified foods are essential for individuals with chewing and swallowing difficulties and must combine appropriate texture with adequate nutritional value, safety, and sensory quality. Currently, many commercially available products are only available in frozen formats. Therefore, this study investigates the use of different processing technologies to develop fresh texture-modified salmon products with improved quality, safety, and shelf-life.

Material and methods: Fish protein hydrolysate and pea starch concentrate were added together with pre-cooked salmon to make a product enriched with proteins. After homogenization, the ingredients were filled into plastic casings and subjected to various processing treatments. These included high pressure processing (600 MPa), high pressure combined with mild heat (600 MPa, 30 °C), conventional heat treatment (90 °C) and freezing (-20 °C). Following processing, samples were stored and analyzed at selected time points, up to day 42.

The effects of the different treatments on microbiological quality (total aerobic count, aerobic spores), pH, texture (back extrusion), and rheological properties (flow sweep, amplitude sweep) were evaluated throughout the storage period.

Results and discussion: The microbiological quality of the texture-modified products remained largely unchanged throughout the storage period. Even after 42 days of storage, only minimal bacterial growth was observed, including both vegetative cells and spore-forming bacteria. Texture and rheological analyses showed that HPP-HT produced the firmest structure and highest viscosity throughout storage, while HPP and heat treatment alone resulted in more stable quality attributes over time.

Conclusion: The study has provided insight into how processing strategy influences both shelf life and quality-related properties of texture-modified salmon products. The results of this study are relevant for further work on the development of nutritious, gently processed foods intended for consumer groups requiring texture-modified diets.

F206 - Influence of different resting conditions during intermittent drying on water behavior and quality of salted-dried mullet roe

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Salted-dried mullet (*Mugil cephalus*) roe is consumed worldwide. The manufacturing process of salted-dried mullet roe includes salting, desalting, and intermittent drying. Intermittent drying involves resting periods to promote water diffusion from the interior to the surface. Particularly, pressing and wrapping are performed during the resting periods to produce salted-dried mullet roe. These treatments are considered to influence water distribution and product quality. However, the detailed influence of different resting conditions (pressing, wrapping, and pressing-wrapping) on the water behavior and quality of salted-dried mullet roe remains unclear. Therefore, this study investigated the effects of these resting conditions.

Raw mullet roe was salted and then desalted before drying. Intermittent drying of mullet roe was conducted in an air-dryer at 15 °C and 45% relative humidity for 20 days. There were four different resting conditions: (1) drying without a resting period (control), (2) pressing the sample with a 2 kg weight for 16 h/day (pressing), (3) wrapping the sample with plastic film for 16 h/day (wrapping), and (4) pressing the sample wrapped with plastic film for 16 h/day (pressing-wrapping). Nondestructive evaluation using nuclear magnetic resonance imaging (MRI) was performed to observe water behavior in mullet roe. Moisture content, Young's modulus, and color were measured after the drying process.

The signal intensity of the pressed and control samples in ¹H T₂-enhanced images was low and homogeneous at 15 and 20 days, whereas the wrapped and pressed-wrapped samples exhibited higher signal intensity in the central region. The moisture content of the pressed sample was lower than that of the wrapped and pressed-wrapped samples. These results indicated that pressing was the most effective resting condition in promoting moisture removal from mullet roe. Furthermore, an increase in Young's modulus and acceleration of browning were observed in the pressed sample. The pressed sample did not exhibit the surface irregularities and internal cracking observed in the control sample.

Therefore, pressing is effective not only in achieving more uniform water distribution and accelerating drying but also in enhancing the visual properties of salted-dried mullet roe, including shape retention and crack prevention.

S201 - Effect of cold plasma treatment on quality parameters of fish protein hydrolysates obtained from Atlantic mackerel side streams

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To improve the quality of the recovered lipid and protein ingredients, advanced non-thermal technologies such as ultrasound (US), can be used as pre-treatments before enzymatic hydrolysis.

The present study aims at investigating the effect of US pre-treatment before enzymatic hydrolysis on quality parameters of both soluble and insoluble protein fractions obtained from Atlantic mackerel side streams. In total, four insoluble fractions were obtained: control without US-treatment and US-treated samples at 300 W, 450 W and 600 W at 20 kHz before enzymatic hydrolysis.

The results demonstrated that US pre-treatment produced FPHs with better quality characteristics compared to the control. Specifically, FPHs from US-treated mackerel mince were lighter, less reddish, and contained a lower proportion of hydrophobic free amino acids, which are associated with bitterness. Additionally, FPH samples obtained from US-treated fish mince exhibited higher protein solubility and degree of hydrolysis than the control (untreated). In addition, US-treatment resulted in significant ($p < 0.05$) increase in total protein content in insoluble protein fraction US-treated at 300 W. However, it was a significant increase in salt-soluble proteins in the sediment samples ultrasonicated at 450 W and 600 W, accompanied by a significant increase in water-soluble proteins in the sample 600 W compared to control. This tendency can be explained by breaking down hydrogen and hydrophobic bonds of both types of proteins due to stronger cavitation effect at higher US intensities, leading to the exposure of hydrophilic groups of amino acid residues. This resulted in protein oxidation of the insoluble protein fractions, by reducing total thiols in all US-treated samples compared to control due to unfolding of proteins and breakage of disulfide bonds. However, in regard to lipid oxidation in insoluble protein fractions containing phospholipids, there was no significant differences in secondary lipid oxidation products expressed between the samples.

From the nutritional perspective, the nutritional indexes of lipid quality AI (atherogenicity index), TI (thrombogenicity index), and HH (hypocholesterolemic fatty acid ratio) were favourable for all insoluble protein fractions. However, US-treatment significantly improved hypocholesterolemic profile of US-treated insoluble protein fractions compared to control, increasing their beneficial effect to healthy cholesterol metabolism.

Regarding color parameters, no significant differences in lightness, redness and yellowness between control and insoluble protein fractions after US-treatment at 300 W and 450 W, were found.

Thus, it was revealed that US-treatment of Atlantic mackerel side streams before enzymatic hydrolysis can significantly improve physicochemical and nutritional quality of both soluble and insoluble protein fractions.

S202 - Thermal Inactivation and Structural Disruption Influence the Fate of Ani s 4 in *Anisakis* Larvae during in-vitro gastric and gastrointestinal digestion

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Anisakis spp. third-stage larvae (L3) are important foodborne parasites associated with anisakiasis and IgE-mediated allergic reactions. Although thermal treatments effectively inactivate the larvae under several time–temperature combinations, little is known about the fate of *Anisakis* allergens during human gastrointestinal digestion following such treatments. Among them, Ani s 4 is a clinically relevant allergen, recognized by approximately 27% of sensitized patients and reported to be resistant to gastric digestion. The aim of this work was to evaluate protein release and the persistence of Ani s 4 during in vitro gastric and gastrointestinal digestion.

Three independent biological replicates were performed using larvae previously identified by molecular analysis and three experimental conditions were evaluated: untreated live larvae, thermally inactivated intact larvae, and thermally inactivated mechanically disrupted larvae, the latter included as a reference condition representing complete loss of larval structural integrity.

The INFOGEST protocol was adapted for *Anisakis* larvae in terms of sample preparation, digestion conditions and enzyme inactivation to preserve soluble digestion products for subsequent biochemical, immunological and cell-based analyses. Total soluble protein was quantified using the Pierce BCA assay, while Ani s 4 was determined by immunodetection using recombinant Ani s 4 as calibration standard.

Protein release depended strongly on larval structural integrity during the gastric phase, with mechanically disrupted larvae producing the highest soluble protein concentrations, followed by thermally inactivated intact L3 and live L3. After completion of the intestinal phase, differences in total protein content became less pronounced. In contrast, the behaviour of Ani s 4 differed from that of total protein. During gastric digestion, mechanically disrupted larvae showed the highest Ani s 4 immunoreactivity, indicating rapid allergen release following disruption of larval tissues. However, after the intestinal phase, Ani s 4 immunoreactivity was markedly lower in extracts obtained from mechanically disrupted larvae, whereas relatively higher Ani s 4 immunoreactivity was detected in extracts obtained from intact thermally inactivated and live L3. These findings suggest that larval structural integrity influences not only protein release but also the Ani s 4 immunoreactivity throughout gastrointestinal digestion.

Overall, the results show that thermal treatment and associated structural changes can markedly affect the digestive fate of *Anisakis* proteins and allergens. This knowledge may contribute to a better understanding of allergen bioaccessibility and persistence and support a more accurate assessment of the allergenic risk associated with processed fish products.

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S203 - Comparative Efficacy of Antioxidant Formulations in Preserving the Quality of Baltic Herring Mince

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Baltic herring (*Clupea harengus membras*) is a small pelagic fish rich in essential elements, vitamins and polyunsaturated fatty acids (PUFAs), with considerable potential for better utilization for food. However, its highly unsaturated lipids, combined with elevated heme-levels, make it highly susceptible to oxidation during storage, resulting in losses of sensory and nutritional quality, limiting its further processing. This study evaluated commercial antioxidant formulations containing e.g., propyl gallate, rosemary extract, olive pomace, or citrus peel for their ability to delay lipid oxidation in Baltic herring mince. Addition levels were selected to not exceed the maximum approved amount of the active components according to EFSA. Samples were stored under chilled conditions for up to 23 days while following primary and secondary lipid oxidation products as peroxide value (PV) and thiobarbituric acid reactive substances (TBARS), respectively. Storage trials were ended when bacterial spoilage was sensorially evident. PV and TBARS results showed clear differences in the ability of the antioxidant formulations to delay lipid oxidation in Baltic herring mince. No oxidation was detected with the propyl gallate- and rosemary extract-based formulations, and they maintained the lipid oxidation lag phase for at least 23 and 14 days, respectively. By comparison, the olive pomace- and citrus peel-based formulations had a weaker stabilizing effect, with the lag phase lasting only about 3 days and <1 day, respectively. An internal sensory screening for rancid odour generally supported the lipid oxidation measurements. Results from dose-response experiments with the most effective antioxidants, i.e., the propyl gallate and rosemary extract-based ones, will also be revealed. Our findings support the selection of suitable commercial antioxidant systems to improve storage stability of herring mince and facilitate its development as a stable, ready-to-use, intermediate raw material for value-added seafood processing.

S204 - Elemental Composition of Farmed and Wild European Sea Bass (*Dicentrarchus labrax*): Potential Biomarkers for Production Origin Discrimination

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The present study aimed to compare the elemental composition of farmed and wild European sea bass (*Dicentrarchus labrax*) to identify potential chemical markers capable of discriminating their production origin.

Muscle samples from both groups were analysed for essential and potentially toxic elements. Macroelements (Mg, K, and Na) and trace elements (Fe, Zn, Cu, Mn, Cr, and Ni) were quantified by flame atomic absorption spectrometry (FAAS), while phosphorus (P) was determined by molecular absorption spectrometry. Total mercury (Hg) was quantified by atomic absorption spectrometry using an automated mercury analyser, following the EPA standard method³. Cadmium (Cd) and lead (Pb) concentrations were determined by graphite furnace atomic absorption spectrometry (GFAAS) according to NP EN 14084 (2003).

The mineral composition differed between farmed and wild sea bass. Farmed specimens exhibited significantly higher concentrations of K, P, and Zn, whereas wild fish showed significantly higher Na levels. No significant differences were observed for Mg, Fe, Cu, Mn, Cr, or Ni between production origins. Cadmium and Pb concentrations were consistently below the respective limits of quantification (0.006 mg kg⁻¹ and 0.06 mg kg⁻¹). Total Hg concentrations were significantly higher in wild sea bass than in farmed specimens. Nevertheless, all Hg concentrations remained below the maximum levels established by the European Union legislation (EU, 2023).

Overall, both farmed and wild European sea bass constitute valuable dietary sources of essential minerals. However, the observed differences in elemental composition, particularly for K, P, and total Hg, suggest that these elements may represent useful biomarkers for discriminating the production origin of European sea bass.

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F207 - Understanding lipid oxidation in macroalgae - case studies with sea lettuce (*Ulva fenestrata*)

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Although macroalgae, i.e., seaweed, accumulate low levels of lipids, their polar nature, high PUFA-levels and co-existence with e.g., pigments, and enzymes in membranes provide a risk for oxidation. At the same time, seaweed is enriched in a diverse pool of antioxidants, but to date, very little is known about how the anti- to pro-oxidant balance in seaweed translates into oxidation progression, and subsequently into quality chances. Throughout the Sweaweed, BlueGreen, Blue Food and CirkAlg projects, we have explored oxidation in red and green seaweed species during storage and downstream processing, but also the role of seaweed in preventing oxidation of other marine lipids. Here, selected results on sea lettuce (*Ulva fenestrata*) lipid oxidation will be presented.

When storing oven dried (40°C) *U. fenestrata* biomass ≤370 days, moderate levels of aldehydes (MDA, HHE, HNE) developed parallel to great losses of PUFA and ascorbic acid. Storage in full light versus semi-light or darkness stimulated PUFA loss as well as pigment bleaching. In later studies with extended storage (550 days in darkness) and varying drying temperatures (40 or 60°C), significant changes in volatile organic compounds (VOCs), sensory profiles and pigments were recorded. Among VOCs, hexanal, pentanal, heptanal, benzaldehyde, and 2,4-heptadienal dominated, but revealed different kinetics. Drying at 60°C preserved green colour and reduced storage-induced VOC-development better than 40°C-drying. Seaweed and ocean odour decreased over time, while rosehip soup, grass and hay odours increased. Also during protein extraction from *U. fenestrata*, oxidation-derived aldehydes as well as furans developed. When added to emulsions, extracts had lower grassy odour but higher bitterness than non-processed biomass.

In conclusion, lipid oxidation progressed both during storage and processing of *U. fenestrata*; particularly after low-temperature drying and in presence of light. However, its effect on end-uses of the biomass -e.g., as a flavour enhancer, colourant or nutrient carrier- needs further attention.

Note that author affiliations applying when the studies were carried out are shown.

F208 - Microbial Source Tracking along the Aquaculture Fish Production Chain Using Fingerprinting Approaches

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Aim: Aquaculture fish production involves multiple potential routes of microbial contamination associated with rearing water, feed, production environments, equipment, contact surfaces, and handling practices. Conventional quality assurance procedures can detect microorganisms but often have limited capacity to determine their origin or clarify how they are introduced and transferred throughout the production chain. This work aims to propose an integrated microbial detection and source-tracking framework using fingerprinting to identify shared contamination signatures, potential sources, persistence niches, and critical transfer points.

Material/methods/design: A systematic sampling strategy is proposed across representative stages of aquaculture fish production. Samples may include rearing water, fish feed, tanks, holding vats, equipment, food-contact and working surfaces, biofilms, and fish products. Microbial detection and source tracking can be performed using real-time PCR coupled with high-resolution melting analysis (qPCR-HRM) targeting selected microorganisms and genetic determinants. Targets may include spoilage-associated microorganisms, seafood-borne pathogens, virulence-associated genes, and antimicrobial-resistance genes. Comparison of HRM profiles from samples collected at different production stages identify identical or highly similar microbial fingerprints and support the investigation of contamination sources and transmission pathways.

Results and Discussion: The proposed approach reveals potential contamination routes within the aquaculture production chain. Samples exhibiting identical or highly similar microbial fingerprints may indicate a common source, shared exposure, or transfer pathway, such as water-to-fish or surface-to-fish-product transmission. Matching qPCR-HRM profiles in water, biofilms, surfaces, and fish samples may help identify microbial reservoirs, persistence niches, and cross-contamination pathways. However, profile similarity alone does not prove direct transmission and should be interpreted together with spatial, temporal, and production-related information. The combined interpretation of fingerprinting results and quality-control data, including time and temperature records, CCP and OPRP monitoring, and verification of handling, cleaning, and sanitation practices, could provide an integrated decision-support tool for quality and safety management.

Conclusions: Microbial fingerprinting could support a shift from intermediate- and end-product testing towards chain-wide microbial surveillance and source tracking. By identifying contamination signatures and their likely routes, the framework could guide targeted preventive and corrective actions. Its incorporation into an intelligent data-integration and decision-support platform could improve seafood quality and safety management and increase confidence in aquaculture products safety.

F209 - Omics in Fish/Seafood safety: Modernizing Microbiological Risk Assessment and Regulatory Frameworks for Foodborne Pathogens and Antimicrobial Resistance

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Aim of research: Fishery products are highly perishable foods with complex microbial ecology and multiple contamination routes from aquatic environments, harvesting areas, aquaculture, processing, storage and distribution. Their safety is increasingly challenged by foodborne pathogens, spoilage-associated microorganisms, antimicrobial resistance (AMR), climate-sensitive hazards and globalized supply chains. This work aims to discuss how omics and next-generation sequencing approaches can support the modernization of microbiological risk assessment and regulatory frameworks for fishery products.

Material/methods/design: The work is designed as a conceptual and regulatory-oriented analysis, using fishery products as a case-study sector. It evaluates the contribution of genomics, metagenomics, transcriptomics, proteomics, metabolomics and multi-omics to the main components of microbiological risk assessment: hazard identification, hazard characterization, exposure assessment and risk characterization. Particular emphasis is placed on the interpretation of omics findings for foodborne pathogens and AMR, and on their translation into risk-relevant evidence for regulatory decision-making.

Results and discussion: Omics approaches can improve hazard identification through strain-level pathogen discrimination and detection of virulence, persistence and AMR markers. Functional omics can strengthen hazard characterization by revealing stress responses, survival mechanisms and phenotype-related traits under seafood-relevant processing and storage conditions. Metagenomics and whole-genome sequencing can support exposure assessment by identifying contamination routes, persistence niches, microbial community interactions and source attribution across the seafood chain. In risk characterization, omics-derived data can reduce uncertainty and improve predictive assessment of microbial growth, survival and consumer exposure. However, detection alone is not sufficient for regulatory action. For AMR, the presence of resistance genes should be interpreted together with host association, genetic mobility, viability, phenotype or expression, food matrix, contamination level and plausible exposure pathways.

Conclusions: The integration of omics into seafood safety governance requires validated workflows, harmonized reporting formats, minimum metadata requirements, uncertainty statements and clear decision criteria. A modernized framework should link omics-derived evidence to practical risk-management actions, including targeted monitoring, traceback, sanitation redesign, HACCP revision, shelf-life reassessment, AMR follow-up testing, training and risk communication. This transition would support more preventive, evidence-based and One Health-oriented management of foodborne pathogens and AMR in fishery products.

F210 - Predicting emaciation-related muscle quality in Atlantic cod (*Gadus morhua*) using Fulton's condition factor and hepatosomatic index

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Aim of research: This study evaluated whether simple biological condition indices can be used to predict emaciation-related muscle quality defects in Atlantic cod (*Gadus morhua*). Specifically, we assessed the ability of Fulton's condition factor (K-factor) and hepatosomatic index (HSI) to identify fish at increased risk of developing gelatinous texture and atypical white muscle colouration.

Materials/methods/design: Threshold values for K-factor and HSI were established using data from a controlled feed-deprivation experiment involving live-stored Atlantic cod. Fish were classified according to the presence or absence of emaciation-related muscle defects (atypical white colour and gelatinous texture) based on sensory evaluation. Fulton's condition factor was calculated from both total body weight (KTW) and somatic weight (KSW). Bootstrapping was used to estimate threshold values separating poor, intermediate and good quality categories. The proposed thresholds were subsequently validated using three independent commercial-scale live-storage trials. Cohen's kappa coefficients (κ) were used to assess agreement between threshold-based predictions and observed muscle quality.

Results and discussion: Fish exhibiting gelatinous texture and atypical white muscle colour showed significantly lower KTW, KSW and HSI values than fish without these defects. Threshold values defining poor quality were identified as ≤ 0.66 for KTW, ≤ 0.58 for KSW and ≤ 2.12 for HSI. When applied to independent datasets, KSW provided the most consistent predictions of muscle quality. The proportion of fish classified as poor quality based on KSW closely matched the prevalence of sensory-assessed defects across trials. Agreement between threshold-based predictions and observed muscle quality was moderate ($\kappa = 0.49$) for KSW and slightly higher for HSI ($\kappa = 0.50$), although HSI tended to overestimate poor quality due to its greater sensitivity to early depletion of liver energy reserves. External visual assessment of emaciation was a less reliable indicator of underlying muscle quality defects.

Conclusions: Simple biological indices can be used to support early identification of cod with increased risk of emaciation-related muscle quality defects. Among the indices evaluated, K-factor calculated from somatic weight (KSW) was the most reliable and practical predictor. The proposed threshold values may support proactive quality management in live-storage systems and conventional cod supply chains by facilitating quality monitoring, production planning and informed harvesting decisions.

F211 - How Much Seaweed Is Too Much? Finding the Safe Consumption Window with Extreme Value Theory

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Aim of research: Seaweed is an emerging food in Western diets, offering important nutritional benefits, particularly as a rich source of iodine, an essential nutrient for thyroid function, growth, and neurodevelopment. However, it may also pose health risks due to excessive iodine intake, which can impair thyroid health, and the presence of inorganic arsenic, a toxic contaminant associated with long-term adverse health effects. Developing evidence-based consumption advice requires balancing these risks and benefits under realistic consumption scenarios. This study aimed to establish consumption recommendations for different seaweed groups and species using an innovative probabilistic risk-benefit approach based on Extreme Value Theory (EVT).

Material/Methods/Design: A risk-benefit assessment was conducted using occurrence data for iodine (I), total arsenic (tAs), inorganic arsenic (iAs), and available bioaccessibility data across green, red, and brown seaweeds. Deterministic and probabilistic approaches were compared, with the latter incorporating EVT to better characterize high-exposure scenarios and provide more realistic consumption estimates.

Results and Discussion: Considerable variability was observed in iodine and arsenic concentrations among seaweed groups. Brown seaweeds presented the highest iodine concentrations (up to 16,700 mg/kg dw; mean $2,031 \pm 2,627$ mg/kg dw), followed by red (up to 5,700 mg/kg dw; mean 366 ± 929 mg/kg dw), while green seaweeds contained substantially lower levels (up to 475 mg/kg dw; mean 83 ± 88 mg/kg dw). Brown seaweeds also showed the highest concentrations of tAs (up to 340 mg/kg dw) and iAs (up to 88 mg/kg dw). Bioaccessibility data indicated high bioaccessible fractions for tAs and iAs and, except for some green species, also for iodine. Compared with deterministic assessment, the probabilistic approach provided a more refined characterization of exposure and resulted in more conservative consumption recommendations.

Conclusions: The probabilistic EVT-based framework improves the realism of seaweed risk-benefit assessment and supports evidence-based consumption recommendations. Species of the genera *Laminaria* and *Saccharina* should be consumed no more than one 2.6 g (dry weight) serving per month, whereas species with lower iodine contents, such as *Alaria esculenta*, may represent a suitable option for populations with insufficient iodine intake, allowing moderate consumption of one 2.6 g (dry weight) serving per week.

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F212 - Circular Economy-Based Valorisation Strategies for Parasitized Fish Along the Seafood Value Chain: Black Scabbardfish, Pouting and European Hake as case studies

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The increasing detection of fish-borne parasites in seafood intended for human consumption poses a significant challenge to seafood safety and public health. Among zoonotic parasites identified, *Anisakis* spp. is one of the most significant hazards associated with marine fish products due to their capacity to cause anisakiasis and allergic reactions in humans. Black scabbardfish (*Aphanopus carbo*), pouting (*Trisopterus luscus*), and European hake (*Merluccius merluccius*) are commercially important species that frequently harbour zoonotic and non-zoonotic parasites, raising concerns regarding consumer safety and product quality, as parasites can cause visible alterations in the edible tissues. Beyond public health implications, parasite infections reduce consumer acceptance and commercial value, causing economic losses from inspection costs, manual removal, batch rejection, mandatory treatments and food waste. Although the EU legislation minimises the risk of viable parasites through mandatory freezing or heat treatments, *Anisakis* allergens may remain active after processing. Therefore, science-based strategies integrating parasitological risk with fish quality attributes are needed to support differentiated utilization pathways for sustainable valorisation of parasitized fish, being this was the aim of the present study.

The approach integrated sanitary risk assessment, parasite burden, fish quality parameters (nutritional composition and organoleptic characteristics), and technological potential for raw material utilisation. Specimens of each species (n=120), collected between summer 2023 and spring 2024, were comprehensively evaluated.

Black scabbardfish and European hake exhibited a high prevalence of *Anisakis* spp. (100%), whereas pouting showed a high prevalence of *microsporidians* (91%) and *Anisakis* spp. (59%), but a low prevalence of *Kudoa* spp. (6%). Despite the high parasitic prevalence, no significant effects were observed on the nutritional composition or muscle texture of any fish species, indicating that parasite infection did not compromise the intrinsic or technological quality of edible muscles.

Based on parasite load, tissue integrity, and potential technological performance, a species-specific value-enhancement framework was proposed classifying fish into three infection categories to guide the most appropriate processing and utilization routes. Lightly infected muscle can be frozen (-20°C/24h) for human consumption, with allergen labelling; moderate-to-severe tissue and recovered non-parasitized portions yield fishmeal, oils and hydrolysates (agricultural hydrolysates only for BSF, pending mercury verification), while viscera are valorised as silages or hydrolysates for agriculture.

This risk-based approach supports more efficient resource utilization, reduces unnecessary economic losses, and contributes to the implementation of circular economy principles in the fisheries sector while maintaining food safety standards.

Funding: "Blue Bioeconomy Innovation Pact" (C644915664-00000026) financed by NextGenerationEU-PRR.

F213 - Co-occurrence of microplastics and chemical contaminants in canned tuna from the Portuguese market: Implications for dietary exposure and human health

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The increasing consumption of canned tuna (CT) has raised concerns regarding consumer exposure to legacy and emerging chemical contaminants, including microplastics (MPs), bisphenols (BPs), pesticides, flame retardants, and dioxins. MPs may act as vectors for these contaminants, potentially increasing their bioavailability and subsequent risks to human health. This study provides the first comprehensive assessment of the co-occurrence of MPs and multiple legacy and emerging organic contaminants in CT available on the Portuguese market.

Three CT brands in brine and sunflower oil were analyzed. Moisture, protein, fat, ash, and energy were assessed via AOAC methods. MPs extraction followed a protocol optimized by our research team, and polymers were identified by Fourier-transform infrared spectroscopy (FTIR). Chemical contaminants, i.e. BPs, organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), dioxins (PCDDs), organophosphate pesticides (OPPs), and organophosphate esters (OPEs), were determined via gas chromatography, and, when applicable, coupled to either an electron capture or flame photometric detector and confirmed by tandem mass spectrometry.

Lipid content varied significantly between brands, attributable either to formulation, interspecific/intraspecific variability, or seasonal effects. All samples contained MPs, with concentrations varying significantly among brands and generally exceeding those reported in comparable European studies. MPs contamination was likely originated from multiple sources, e.g. marine environment, industrial processing, packaging materials. No relationship was observed between MP concentrations in tuna tissue and the filling medium, suggesting negligible migration from medium to tuna. Furthermore, either BPs, OCPs, or OPEs were detected in all cans, demonstrating the widespread co-occurrence of MPs and chemical contaminants. Specifically, tuna BPs concentrations exceeded EFSA dietary exposure guidance values, raising potential concerns for consumer health.

These findings demonstrate that CT co-contamination of MPs and diverse chemical contaminants potentially originates from environmental and anthropogenic sources. Large-scale monitoring programmes are necessary to better elucidate contamination pathways and support more robust risk assessments.

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F214 - Impact of *Anisakis* spp. infection on quality of black scabbardfish (*Aphanopus carbo*) fillets assessed through physical parameters

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Black scabbardfish (*Aphanopus carbo*, BSF) is a commercially important deep-water species widely distributed throughout the Northeast Atlantic, from the Denmark Strait and Iceland to the Canary Islands. The main fishing grounds include the Madeira and Azores archipelagos and mainland Portugal. In Portuguese waters, BSF exhibits a high prevalence of *Anisakis* spp. Such infection is largely due to its predatory feeding behaviour and high trophic position, which favours the accumulation of infective larvae through trophic transmission. Besides representing a food safety concern because of its zoonotic potential, *Anisakis* infection has been associated with muscle degradation, colour changes, reduced texture quality, and decreased marketability in several commercial fish species. However, information on the impact of *Anisakis* infection on the quality of BSF fillets remains scarce.

This study evaluated the relationship between *Anisakis* infection intensity and the quality of BSF fillets assessed through physical parameters. A total of 120 BSF specimens were collected from Sesimbra fishing grounds (mainland Portugal) between summer 2023 and spring 2024 (30 fish per season). Fish were transported under refrigerated conditions to the laboratory. Before quality assessment, all specimens were examined for the distribution and quantification of *Anisakis* spp. larvae in the viscera and muscle, allowing each fish to be classified according to parasite load. Fillet quality was evaluated in dorsal muscle using instrumental methods. Muscle pH was measured with a pH meter, texture was assessed as firmness by puncture test using a texture analyser, and colour was measured as CIE L*, a* and b* coordinates.

The degree of *Anisakis* infection in viscera and muscle did not significantly influence any evaluated quality parameter. Post-mortem texture (firmness 119.6-168.6 g), pH (6.59-6.89), and colour (whiteness: 49.1-52.0) were comparable among fish with different parasite levels. No evidence of muscle softening, colour deterioration, or pH alterations associated with parasite infection was observed. These findings contrast with quality defects reported in other commercial fish species and suggest that the naturally firm muscle of BSF is not affected by *Anisakis*.

Although parasite burden was not indicative of fillet quality deterioration, the high prevalence of this zoonotic nematode highlights the importance of implementing regular monitoring and appropriate inspection procedures to ensure consumer safety and compliance with food safety regulations.

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F215 - Immersion infection as a tool to study vibriosis dynamics in juvenile European seabass (*Dicentrarchus labrax*)

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European seabass aquaculture has expanded considerably, accompanied by an increased occurrence of bacterial diseases, particularly vibriosis. Among *Vibrio* species, *Vibrio harveyi* is a major pathogen responsible for significant economic losses in aquaculture. *Vibrio rotiferianus*, meanwhile, is increasingly detected in marine farming environments, although pathogenicity remains poorly understood. In this context, experimental bacterial challenges represent an essential tool for investigating host-pathogen-environment interactions and vibriosis progression. Therefore, funded by the InovAQtion FEAMPA project, this study aimed to (i) establish an immersion-based bacterial challenge protocol for juvenile European seabass using three *Vibrio* strains isolated from diseased fish from an aquaculture facility and included in the autovaccine, (ii) determine the bacterial concentration required to induce vibriosis and (iii) characterize infection progression in seabass through biomolecular analyses of the gills, spleen and intestine. Immersion infection with one *V. harveyi* strain successfully induced vibriosis in juvenile European seabass, resulting in clinical signs and mortality rate exceeding 50% within a few days post-infection at one concentration. In contrast, other strains showed very low mortality, even at high concentrations. Biomolecular analyses revealed significant bacterial colonization in the gills, followed by the spleen and intestines. These results demonstrate the effectiveness of immersion infection models in reproducing vibriosis in European seabass, as well as the differences in virulence among *Vibrio* strains. This experimental model is a valuable tool for improving our understanding of host-pathogen-environment interactions, and subsequent research into the influence of biotic and abiotic parameters will lead to improvements in farming practices to reduce vibriosis.

F216 - Distribution of PCBs, Dioxins, and PFASs in the Organs of Baltic Herring (*Clupea harengus membras*): Implications for Whole-Fish Utilization

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The elevated levels of environmental contaminants, such as dioxins, PCBs, and PFASs, in herring (*Clupea harengus membras*) catches from certain regions of the Baltic Sea cause a detrimental market value for this biomass, despite its high nutritional properties and low environmental impact. While dioxins and PCBs are highly lipophilic, PFAS span a much broader polarity range, and can partition into both aqueous and lipophilic phases. With the ultimate goal to use more of the Baltic herring catches for food, preferably without being limited to fillets, which are both difficult and inefficient to produce from this small-sized species, the present study aimed to better understand the distribution of PCBs, dioxins, and certain PFASs (PFOS, PFHxS, PFNA, and PFOA) in all the organs of Baltic herring. This would allow selective removal of the organs with highest contaminant levels.

All organs were dissected, separated, homogenized, and pooled prior to analysis. The organ samples were analysed for PCBs, dioxins, and PFASs using LC-MS/MS, as well as for proximate composition, i.e., crude protein, lipid, and moisture content. Our results revealed that PCBs and dioxins were found at concentrations of 0.35–8.60 pg/g ww with the highest levels being found in skin; exceeding the maximum level set by the EU at 6.5 pg/g ww. For PFASs, concentrations between 7.25 and 273.32 ng/g ww were found, with all organs except one (muscle), exceeding the maximum level set at 8.0 ng/g ww. The most PFAS-dense organ was the intestine. Based on these results, future research and new food processing strategies are needed to selectively remove the most POPs-enriched organs while still maintaining maximum biomass yield. Also, particularly for PFAS, fractionation technologies for the pre-cut raw material are needed to further lower the levels and ensure safe food intake.

F217 - Contaminant Metals in Marine Bivalves and Gastropods from the South Coast of Portugal

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Metal contamination in coastal ecosystems remains a persistent environmental and public health concern due to the toxic and bioaccumulative properties of cadmium (Cd), lead (Pb), and mercury (Hg). Monitoring conducted by the Portuguese Institute for the Sea and Atmosphere has consistently reported elevated Cd concentrations in limpets (*Patella spp.*) collected from the southern Portuguese coast, particularly along the Setúbal–Sines and São Vicente–Lagos coastal regions. This study aimed to assess the concentrations of Cd, Pb, Hg, copper (Cu) and zinc (Zn) in limpets, trumpet shells (*Charonia lampas*) and blue mussel (*Mytilus edulis*), and to apply risk characterization metrics associated with their consumption.

Samples were analysed using atomic absorption spectrometry and direct mercury analysis, and the resulting data were assessed according to European Union regulatory limits. The estimated daily intake (EDI) for Cd, Pb and MeHg was calculated, assuming a daily consumption rate of 100 g of seafood and a standard adult body weight of 70 kg.

Species identity explained the largest proportion of variation in contamination profiles, indicating that ecological traits were the dominant drivers of metal accumulation. Although most metal concentrations complied with current European regulatory limits, some Cd values obtained in limpets and Hg values observed in trumpet shells exceeded the EU limits, respectively of 1 ppm and 0.3 ppm for these compounds. However, the lack of specific maximum limits for Cd in marine gastropods represents an important regulatory gap in seafood safety assessment.

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S205 - Farmed and wild European sea bass: fatty acid signatures for traceability

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Aim research: The European sea bass (*Dicentrarchus labrax*) is a commercially valuable marine species widely produced through aquaculture in Mediterranean and Atlantic regions. Given the growing importance of sustainable seafood production, understanding how farming practices influence its nutritional composition is essential. This study compared the lipid composition of farmed and wild European sea bass, **aiming to decode how farming practices impact nutritional quality while providing a lipidomic blueprint for product traceability.**

Material/methods/design: Muscle samples collected in May/2026 from wild (n=8) and farmed (n=10) were analysed for total lipids (Bligh and Dyer method), while lipid classes and fatty acid (FA) composition were determined by high-performance thin-layer chromatography and gas chromatography, respectively.

Results and discussion: Farmed sea bass exhibited significantly higher fat contents than wild individuals (4.2 and 1.3 g/100 g wet weight, respectively). Storage lipids, mainly triacylglycerols (TAG), predominated in farmed fish, accounting for 45.9% of total lipids, whereas TAG represented less than 1% in wild specimens.

Farmed fish had substantially lower n-3/n-6 polyunsaturated FA (PUFA) ratio (0.8) than wild specimens (3.1). Wild sea bass contained higher proportions of saturated FA and were particularly enriched in the long-chain n-3 PUFA eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3), that accounted 8.9 and 19.5% of total FA, respectively. In contrast, farmed fish showed greater total n-6 PUFA levels, together with increased monounsaturated FA, largely due to the higher abundance in linoleic acid (18:2n-6) and oleic acid (18:1n-9). The found differences are likely associated with differences in diet, environmental conditions, and swimming activity.

Conclusions(s): Overall, farmed European sea bass displayed significantly different lipidomic profiles, which may be attributed to the spawning season that, in the Atlantic, takes place up to June. Consequently, wild individuals sampled within this period may exhibit a typical post-spawning depletion of somatic lipid reserves due to gonadal mobilization, whereas farmed fish maintain stable FA profiles sustained by continuous commercial feeding. Besides, higher total FA content but a less favourable n-3/n-6 ratio than wild fish. The markedly higher 18:2n-6/(EPA+DHA) ratio observed in farmed specimens, reflecting the incorporation of vegetable-derived ingredients in aquafeeds, suggest to be a robust biomarker for distinguishing aquaculture from wild-origin fish. These findings provide valuable insights into the nutritional characteristics of European sea bass and support the use of lipid biomarkers for seafood authentication.

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F301 - What makes seafood sustainable? Moving beyond Life Cycle Assessment to assess fish from cellular agriculture, fisheries or aquaculture

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As cellular agriculture advances toward commercial viability, the sustainability debate is dominated by comparisons with conventional animal production. When considering seafood products, a meaningful evaluation must also include comparisons with wild-capture fisheries and aquaculture production systems. While life cycle assessment (LCA) remains the widely accepted systematic approach to evaluate environmental impacts of products, it is insufficient on its own since it primarily measures consumptions and emissions (e.g., greenhouse gas) related with specific impact categories as climate change, land use, or water consumption, overlooking dimensions unique to marine ecosystems. Wild fisheries depend on dynamic ecosystems and are deeply influenced by stock exploitation, gear impacts, and discards. Aquaculture introduces issues such as nutrient discharge, antibiotic resistance, habitat degradation and the ethical implications of using wild-caught fish for feed. These factors fall outside LCA's scope but are central to sustainability in seafood production. By following a multi-criteria framework that combines LCA results with ecosystem health indicators based on the Scientific, Technical and Economic Committee for Fisheries (STECF) (2021) grading system with a sustainability score, it is possible to have a more holistic overview about environmental impacts of seafood products. Sardine from purse-seine fishery and meagre from recirculating aquaculture system were selected as illustrative examples, relevant to the fisheries context and representative of advances in fish farming. Such examples highlight how environmental sustainability shifts when broader impacts are accounted for and what type of challenges arise on the comparison between different production systems. Embodying the different fish production systems allows reflection on a pluralistic food system, containing contradictory trends, competing stories, with benefits and drawbacks. The different fish production sources do not embody a single, coherent and universal vision of fish production systems. To steer toward 'better' fish products, it is necessary to further explore this complexity, engaging both the potential and the limits of technological innovations. Achieving a consistent, system-wide sustainability framework requires integrating biological, environmental, and technological assessments into a unified methodology, that also reflects the evolving knowledge on fish production and consumption.

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F302 - Assessing sustainability in fish processing using TOPSIS: A case study comparing fresh and salted cod production

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Aim of research: Sustainability assessments in seafood production often involve trade-offs between environmental, economic and social objectives. Improvements in one dimension may come at the expense of another, making production decisions difficult.

This study examined whether the multi-criteria decision-making method TOPSIS can support sustainability assessments in fish processing by integrating multiple sustainability indicators into a transparent decision framework.

Material/methods/design: A case study was conducted in a Norwegian cod-processing company. Two production alternatives were compared: fresh cod and salted cod. Sustainability was assessed using five indicators representing environmental, economic and social performance: energy consumption, packaging use, contribution margin, employee well-being and health, safety and environment (HSE). Production, sales and cost data from 2025 were combined with employee survey data. The indicators were normalised and analysed using TOPSIS. A sensitivity analysis was conducted to evaluate the robustness of the ranking.

Results and discussion: The results demonstrated clear sustainability trade-offs between the two production alternatives. Fresh cod production performed better in terms of energy consumption and HSE, while salted cod production achieved higher scores for contribution margin, packaging efficiency and employee well-being.

TOPSIS integrated these conflicting indicators into a single assessment and ranked salted cod production as the preferred alternative ($C_i = 0.923$) compared with fresh cod production ($C_i = 0.077$). The ranking remained unchanged in all sensitivity analyses, indicating robust results.

At the same time, the study showed that the outcome depends on indicator selection, weighting and operationalisation of sustainability.

Conclusions: TOPSIS proved useful for integrating diverse sustainability indicators and supporting transparent decision-making in fish processing. However, the results remained strongly influenced by indicator selection, data quality and methodological assumptions. Sustainability assessments should therefore be interpreted as decision-support tools rather than objective measures of sustainability.

F303 - Eco-innovative technologies for improved security, sustainable production and marketing of agroecological food products in Africa

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World population and economic growth are expected to increase food demand by 2050. However, food insecurity and malnutrition remain major challenges in Sub-Saharan Africa, where approximately 20% of the population is undernourished and 30% live on less than 2USD per day. Addressing these challenges requires sustainable, climate-resilient food production systems capable of improving nutrition, creating employment, and strengthening rural livelihoods. This work is tackled in the Horizon Europe INNOECOFOOD project (<https://innoecofood.eu/>), which aims to implement innovative agroecological food production systems integrating renewable energy, digital technologies, and circular economy principles to enhance food security and sustainability in Africa.

Four agroecological demonstration facilities (ECOHUBs) were established in Kenya, Tanzania, Ghana, and Egypt. These facilities integrate solar and wind energy with sensor-based monitoring, artificial intelligence (AI), and Internet of Things (IoT) technologies to sustainably produce catfish, tilapia, spirulina, and black soldier flies. Circular bioeconomy approaches were implemented to add value to these products through (i) drying and extrusion technologies and the development of new food products tailored to the demand in these countries, and (ii) valorising co-products to generate innovative ingredients. Nutritional composition, sensory acceptance, microbiological quality, and chemical safety were assessed using standardized methodologies. Environmental performance was evaluated, and a sustainability certification framework inspired by international aquaculture certification schemes was developed. Capacity-building activities included training for 240 women and youth from local communities.

The ECOHUBs demonstrated the technical feasibility of decentralized, renewable energy-powered food production systems adapted to local conditions. A diversified portfolio of nutritious products, including dried fish, fortified porridges, biscuits, soups, and snacks, was developed to address the nutritional needs of vulnerable populations, particularly children. Product validation confirmed their nutritional value, consumer acceptability, microbiological quality, and chemical safety. Circular economy strategies enabled the efficient valorisation of production by-products, reducing waste while creating additional value. Environmental assessments indicated the potential of the ECOHUB model to reduce environmental impacts, while the sustainability certification framework supports market uptake and long-term implementation. Community training strengthened local technical skills and promoted the replication potential of the model across African regions.

The INNOECOFOOD project demonstrates that agroecological food systems integrating renewable energy, AI, IoT, and circular economy principles can support sustainable food production, improve nutrition, and enhance rural livelihoods in Africa. The ECOHUB model provides a scalable and resilient solution for producing safe, nutritious, and marketable foods while promoting environmental sustainability, resource efficiency, and community empowerment.

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S301 - Social Labs as a consumer co-creation tool for upcycled food concepts: results from the Up4Food project

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Aim of research: Food processing side-streams, including those from pelagic fish processing, may provide valuable nutrients for new food concepts. Their valorisation is both a technological and a market challenge. The aim of the research was to develop solutions to facilitate consumer acceptance of food products fortified with nutrients recovered from food side-streams, using ‘Social Labs’ as an approach to consumer research and co-creation that supports development and communication.

Material/methods/design: Social Labs were implemented in the Up4Food project as a two-month group process involving consumers from Norway, Ireland, France, Poland and Romania, as well as other stakeholders. Moderated online work combined individual dialogues, asynchronous discussion forums, online plenary meetings, concept evaluation, polls and surveys. The design integrated qualitative exploration with quantitative measures of preferences, doubts and perceived attractiveness of proposed concepts.

Results and discussion: Preliminary findings show conditional openness to upcycled food concepts. Consumers appreciated reducing food waste and increasing nutritional value, but acceptance depended on perceived safety, trust in recovery methods, transparent information, and the fit between nutrient sources and the final product. Plant-based recovered ingredients were usually considered more natural and safer, while animal-derived ingredients raised more questions about hygiene, processing intensity and quality. For pelagic fish side-streams, contextual fit was crucial: marine-origin nutrients were more readily accepted in fish-based or savoury products than in distant categories. At product level, sensory quality, attractive appearance, familiar taste, reasonable price, clear labelling and avoidance of negative associations with “waste” or “residue” were decisive.

Conclusions: Social Labs proved useful not only for assessing consumer acceptance, but also for explaining consumer reasoning and supporting co-creation. For food processors, including fish processors, this approach can help identify promising concepts, detect barriers early, test communication strategies and reduce the risk of developing products that are technically feasible but poorly aligned with consumer expectations.

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F401 - Salt-Dependent Cryoprotective Effects of Cod Protein Hydrolysates in Frozen Atlantic Cod Mince

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Aim of research: Prolonged frozen storage reduces seafood quality through protein denaturation, oxidation, water redistribution, and textural deterioration. Fish protein hydrolysates (FPHs) are promising alternatives to conventional sugar-based cryoprotectants, but their performance in salted fish muscle systems remains insufficiently understood. This study investigated how 1% (w/w) NaCl affected the cryoprotective efficacy of cod FPHs produced using Alcalase® AF, FoodPro® PNL, and Corolase® 8000 in frozen Atlantic cod mince.

Materials/methods/design: Minced Atlantic cod (*Gadus morhua*) was prepared without additives or with 5% (w/w) cod FPH, sucrose-sorbitol blend (1:1, w/w), NaCl, or their combinations. Samples were stored at -20 °C for up to 4 months. Quality and protein stability were assessed by colour measurement, texture profile analysis, low-field NMR, SDS-PAGE, Ca²⁺-ATPase activity, differential scanning calorimetry, protein carbonyl content, pH, and water content.

Results and discussion: FPH addition reduced quality deterioration during frozen storage, particularly by limiting texture changes and stabilizing water distribution. Salt lowered pH and increased adhesiveness and cohesiveness, while enhancing the ability of FPHs to suppress hardness increase and changes in T22 relaxation, indicating improved water-holding capacity. However, salt also increased yellowness and reduced redness, suggesting possible promotion of pigment or lipid oxidation. SDS-PAGE showed protein degradation in all samples after storage. Salt alone did not provide sufficient myofibrillar protection, whereas FPH-treated samples retained higher Ca²⁺-ATPase activity than the untreated control. Alcalase® AF- and FoodPro® PNL-treated FPHs showed the strongest preservation of myofibrillar integrity, while FoodPro® PNL-treated FPH provided the highest thermal stability. Protein carbonylation did not differ significantly among treatments.

Conclusions: Cod FPHs improved the frozen-storage stability of Atlantic cod mince, and salt modified their cryoprotective performance by improving water retention and textural stability.

F402 - Valorization of enzymatically hydrolyzed cod backbones as a functional ingredient in fish cakes: effects on texture, oxidative stability, and sensory properties

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This study investigated the feasibility of valorizing enzymatically hydrolyzed cod (Atlantic cod) backbones as a functional ingredient in fish cakes, evaluating their effects on texture, sensory properties, and oxidative stability.

Cod backbones obtained after mechanical separation were hydrolyzed using either Alcalase or Formea Sol, while non-hydrolyzed bones served as a control. Following hydrolysis, the material was oven-dried (90°C) and processed into an anhydrous paste containing rapeseed oil and bone powder (1:1, w/w) using a bead mill. The paste replaced 25, 50, or 100% of the oil in the fish cake formulation. Because the paste consisted of equal amounts rapeseed oil and bone powder, the oil fraction replaced the corresponding amount of rapeseed oil, while the bone powder replaced an equivalent amount of fish meat. Fish cakes were oven-cooked (180°C, 14 min), packaged under modified atmosphere (60% N₂/40% CO₂), and stored at 4–10°C for up to 35 days. Texture profile analysis (TPA), sensory evaluation, and oxidative stability (peroxide value, tocopherols, and volatile compounds), were performed during storage.

TPA conducted on days 1, 3, 7, 10, and 14 showed that the original formulation (without added bones) exhibited the highest hardness. Similarly, sensory evaluation (days 1, 7, and 14) indicated that both the original and the non-hydrolyzed bone formulations were perceived as the firmest in-mouth and under the fork. Fish cakes containing hydrolyzed bone paste showed improved oxidative stability, with lower peroxide values after 35 days of storage. Tocopherol levels remained more stable in formulations containing hydrolyzed bones, whereas they declined in the original recipe. Preliminary analysis of volatile compounds suggests no substantial differences between formulations.

Incorporating hydrolyzed cod backbones as a bone paste appears to be a promising strategy for fish cake reformulation. The ingredient had limited effects on texture, improved oxidative stability, and, based on preliminary observations, is not expected to adversely affect microbial stability. These findings support the potential valorization of fish processing side streams as functional food ingredients.

F403 - Prebiotic function and quality parameters of fish protein hydrolysates (FPH) obtained from herring (*Clupea harengus*) side streams by ultrasound pre-treatment before enzymatic hydrolysis

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High value protein ingredients such as fish protein hydrolysates (FPH) can be extracted from fish side streams by conventional enzymatic hydrolysis. To improve this method of extraction, increase the yield and enhance quality of FPH, advanced technologies such as ultrasound (US) can be used as a pre-treatment.

Aim of research: the present study aimed at investigating the effect of US pre-treatment prior to enzymatic hydrolysis on quality parameters of FPH recovered from herring side streams.

Materials and methods: The cut-offs from the filleting of NVG-herring (*Clupea harengus*) collected at a local fish processing facility (Fosnavåg, Norway), were minced, divided into batches of 1 kg, and subjected to US pre-treatment at the power of 600 W, 900 W and 1200 W with a 20 kHz probe for 10 minutes, followed by enzymatic hydrolysis for 1 h with Alcalase enzyme, including control (non-treated) sample. The water-soluble protein phase from each treatment (FPH) was collected and freeze-dried for further quality analysis, including proximate composition, protein solubility, molecular weight distribution, degree of hydrolysis, amino acid profile, protein oxidation, color and prebiotic properties.

Results and discussion: The results of the FPHs quality showed that pre-treatment of herring side streams by US at the maximum power of 1200 W resulted in a significantly higher solubility and degree of hydrolysis due to reduction in peptide particle size, increasing the amount of small (200-500 Da) and medium-size (5000-10000 Da) peptides in FPHs. At the same time, the use of US did not affect significantly the proportion of essential amino acids and oxidation parameters of FPHs. In addition, it was shown that US at 1200 W generated FPH with lower proportion of hydrophobic free amino acids giving less bitterness to the product, as well as with improved color parameters.

The results on the ability of US-treated FPHs to stimulate the growth of beneficial bacterial strains have demonstrated that US at 1200 W produced the strongest stimulation on in vitro multiplication of some probiotic bacteria, leading to substantial increases in viable cell numbers of *Lactococcus lactis* ATCC 49032 and *Bifidobacterium breve* ATCC 15700.

Conclusion: The study findings suggest that both the quality and prebiotic potential of herring FPH samples depend on a combination of factors, including ultrasound power intensity, molecular weight distribution, amino acid profile, beneficial bacteria strain metabolic capabilities and concentration, highlighting the importance of tailoring FPH processing conditions to achieve desired beneficial outcomes.

F404 - Effects of on-board processing of *Gadus morhua* heads on the storage efficiency and the quality of subsequent enzymatic hydrolysis

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Aim of research: The Norwegian seagoing fishing fleet generates more than 110,000 tonnes of rest raw material (RRM) annually, yet only 43% is utilized. One of the main reasons is the relatively low economic value of the raw material. However, this alone cannot explain the low utilization. The aquaculture industry processes raw materials of similar value into food ingredients, nutraceuticals, and feed, achieving utilization rates close to 100%.

The key difference is the limited processing and storage capacity onboard fishing vessels. Any space allocated to RRM reduces the capacity available for gutted fish, making it difficult to justify landing low-value material. Consequently, increasing RRM utilization depends on improving storage efficiency while maintaining sufficient quality for production of high-value products.

Using cod (*Gadus morhua*) heads as a model raw material, this study investigates how onboard processing can improve storage efficiency while evaluating its effects on quality for downstream production of high-value products.

Methods/design: Four processing methods were evaluated: cleaving, compression using a newly developed fish-head compressor, coarse grinding (6 mm), and fine grinding (4 mm). Storage efficiency was assessed by measuring head volume reduction, batch density, and liquid-loss over time under both laboratory and onboard conditions. To determine whether mechanical processing affected the suitability of the material for further valorization, all treatments were subjected to identical enzymatic hydrolysis. The resulting hydrolysates were characterized by amino acid composition, peptide size distribution, protein, lipid, and ash content, together with visual assessment of the resulting fractions.

Results/discussion: Grinding increased storage efficiency by approximately 50%, while compression and cleaving improved storage by approximately 20% without compromising head integrity. Grinding also increased liquid-loss and the presence of blood and bone particles in the hydrolysis sludge. However, amino acid composition and peptide size distribution of the soluble protein remained comparable across all processing methods, indicating that hydrolysate quality was not significantly affected.

Conclusion: Mechanical processing can substantially improve the storage efficiency of cod heads onboard fishing vessels without significantly affecting the quality of the resulting protein hydrolysates. Although grinding provided the greatest increase in storage capacity, it also increased liquid-loss and the presence of blood and bone particles, which may limit certain food applications. Compression, however, improved storage efficiency while largely preserving head integrity. These findings demonstrate that onboard processing can increase transport capacity while maintaining the potential for downstream production of high-value ingredients, thereby supporting increased utilization and value creation from marine side streams.

F405 - Linking Lipid Stability and Resource Utilisation: A Quality Flow Analysis of Herring Processing Side Streams

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Aim of Research: This study evaluated lipid stability in herring side streams from Norwegian spring-spawning herring and explored how quality parameters can be integrated into a Quality Flow Analysis (QFA) framework. The aim was to identify fraction-specific differences in lipid deterioration and assess their implications for utilisation potential.

Materials and Methods: Side streams were collected from industrial herring processing and separated into fractions (head, backbone, skin, belly flap, viscera, tail, and mixed). A storage trial at 4 °C for up to eight days simulated suboptimal industrial conditions. Lipid quality was assessed using indicators of oxidation and hydrolysis, including peroxide value (PV), thiobarbituric acid reactive substances (TBARS), p-anisidine value (AV), total oxidation (TOTOX), and free fatty acids (FFA). Fatty acid composition and pro-oxidant metals (iron and copper) were also analysed. A prototype QFA was developed by combining experimental quality data with mass flow information to visualise quality changes during storage.

Results and Discussion: Lipid stability varied markedly between fractions. Backbone, tail, and belly flap showed rapid oxidation, with several fractions exceeding recommended limits after 2–4 days. In contrast, viscera exhibited low PV but high AV and FFA, indicating advanced oxidation and extensive hydrolysis. FFA increased in all fractions, with significantly higher levels in viscera, reflecting high enzymatic activity. Non-haem iron correlated strongly with secondary oxidation, highlighting the role of intrinsic pro-oxidants.

The QFA model demonstrated how both storage time and fraction composition influence the availability of high-quality lipid resources. While belly flap contributed substantially to lipid yield, inclusion of viscera reduced the overall quality of mixed streams.

These results indicate that bulk handling of mixed side streams may limit value creation.

Conclusion: Lipid stability in herring side streams is highly fraction-dependent, with rapid oxidation and hydrolysis occurring during chilled storage. Fraction-specific handling and rapid processing are therefore essential to maintain quality and maximise value. The QFA approach provides a useful tool for integrating quality and mass flow data, supporting improved utilisation of marine side streams.

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F406 - Future marine food innovation

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The aim of the Future Marine Food Innovation project is to take a more holistic approach to food innovation by developing foods from underutilized biomasses, like algal biomass, and marine side streams, while addressing challenges related to novel food regulations and consumer acceptance during development.

Valorization of side streams and the use of underutilized biomasses are both common research areas within food science. However, research is often narrow in scope and focuses mainly on the extraction of single components and their potential benefits. This approach frequently overlooks important factors such as consumer acceptance, scalability, and regulatory constraints.

One of the main regulatory challenges in food development is the Novel Food Regulation. This regulation requires that food materials or extracts not consumed to a significant extent in the EU before May 1997 must be assessed and approved by the European Food Safety Authority (EFSA) and the European Commission before they can be marketed in the EU. This process is known to take upwards of five years from application to potential approval. The lengthy and demanding approval procedure is costly and limits the number of products that successfully move from research environments to the market, and thus have the potential to become a future marine food.

The project includes collaboration with EFSA to examine challenges within the novel food application process, with the aim of helping producers better navigate and potentially shorten the approval process. In addition, the project will involve a workshop with chefs and food producers to clarify consumer demands and explore new ways of incorporating marine side streams and underutilized biomasses into consumers' everyday diets.

The project started in December 2025 and will run for three years until 2028. The vision of the project and its expected outcomes will be presented with the aim of initiating discussions and establishing potential collaborations.

F407 - Effects of sub-chilling on the quality and stability of Atlantic salmon viscera and fillets.

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Research aim: Sub-chilling (storage below 0 °C) is used in refrigerated seawater (RSW) systems to store bled fish before processing in the Norwegian Atlantic salmon industry, particularly onboard stun-and-bleed vessels. Although sub-chilling has been shown to improve fillet quality and extend shelf life, limited information is available regarding its effects on salmon viscera, a highly perishable raw material with valorization potential. Therefore, the aim of this study was to evaluate the effects of sub-chilling on the quality and stability of salmon viscera and fillets during subsequent storage.

Materials and methods: Ungutted Atlantic salmon (n=40) were stored in RSW at either -1 °C (sub-chilled) or 4 °C (control) for approximately 16 h before manual gutting. Temperature was continuously monitored. Following gutting, viscera were individually vacuum-packaged and stored at their respective temperatures (-1 °C or 4 °C) and sampled at 0, 8, 15, 24, 30 and 48 h. At each sampling point, viscera from three fish were pooled and homogenized. Analyses included pH, colour, proximate composition (lipid, water, protein content), fatty acid composition, free fatty acids (FFA), protein degradation and lipolytic activity. The gutted fish were subsequently stored on ice (0 °C), filleted, and sampled at 0, 6, 9, 12, 15 and 21 days. Fillet quality was evaluated through colour and texture measurements.

Results and discussion: After 16 h of storage, the core temperatures of sub-chilled and control fish reached -0.7 °C and 3.9 °C, respectively. Viscera from the sub-chilled group maintained a higher pH throughout storage, decreasing from 6.89 ± 0.07 to 6.67 ± 0.02 , whereas the control group decreased from 6.83 ± 0.02 to 6.55 ± 0.03 . No significant effects on proximate composition or fatty acid composition were observed. Similarly, FFA levels differed only marginally between treatments after 48 h. Lipolytic activity declined during storage in both groups, although lower activity was observed in sub-chilled viscera at the end of storage. Sub-chilling resulted in a more stable total amino acid profile. Fillet colour and texture decreased through storage, but no significant differences were detected between treatments. Overall, the results indicate that sub-chilling may enhance the stability of salmon viscera without compromising fillet quality.

F408 - What should we do with the dead fish? Safe use of fish mortalities

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Aim of research: The main objective of the dFUSE project is to improve resource utilization and increase value creation from farmed fish that die before harvest by developing knowledge, methods, and technologies that enable safer and more sustainable use of this biomass in higher-value applications.

In Norway, it has been estimated that approximately 130,000 tonnes of salmon and trout died before slaughter in 2022. The most important priority going forward will be to reduce mortality and increase fish welfare. Nevertheless, fish that die before slaughter represent lost nutrients if not utilized.

Current regulations place strict limitations on the use fish that die before slaughter (dead fish). These are primarily categorized as high-risk (Category 2) material and are currently used mostly for biogas production. Fish contain valuable marine oils and proteins and considering global population growth and the increasing demand for aquaculture feed, it is important to explore whether this resource can be utilized more effectively than it is today. The dFUSE project has explored solutions to enable a larger share of these fish to be incorporated into feed value chains.

Results and discussion: The project has mapped the relevant regulations in Norway, studied the quality of Category 2 fish silage, the causes of fish mortality, and evaluated the risks associated with using different dead fish material in feed value chains. The project has explored the potential for using oils or proteins from fish silage, from dead fish in feed for insects and marine invertebrates, and security aspects of such use. The results indicate that a substantial proportion of fish mortalities are associated with causes for which the biological risks appear manageable. In addition, the silage process, combining low pH and heat treatment, effectively inactivates relevant bacterial hazards. Uniform heat transfer is critical. Low trophic species fed spiked fish mince did not contain viable bacteria, although bacterial contamination may still be detected in their feces.

Conclusion: The findings suggest that selected fractions derived from aquaculture mortalities may represent a safe and valuable resource for feed production when appropriate processing and hygienization measures are applied.

S401 - Freeze-dried salmon liver as a potential health supplement

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Salmon aquaculture generates substantial quantities of by-products that are currently underutilised despite their nutritional potential. As Salmon aquaculture is growing in Iceland, finding valorisation pathways is important to increase the sustainability of the practices, mainly focusing on viscera, which is one of the most undervalued fractions. This study was conducted in collaboration between a freeze-drying company Frostþurrkun ehf, Orkidea and Matís.

Liver in particular represents a high-value fraction, rich in protein, omega-3 fatty acids and fat-soluble vitamins, yet its valorisation remains largely unexplored. This study aimed to evaluate the shelf life of freeze-dried salmon liver powder and assess the efficacy of two food-grade antioxidants in limiting lipid oxidation during storage, with a view to developing this by-product as a functional food ingredient or nutritional supplement.

Salmon livers collected from Icelandic aquaculture facilities were pre-treated with a defatting step by treating them in hot water before grinding and freeze-drying. Two antioxidants were incorporated at 1% concentration prior to freeze drying: Vitamin A palmitate (1%VA) and D-Alpha Tocopheryl Succinate (1%T), alongside an untreated control. Freeze-dried powders were stored at -18°C, 4°C, 20°C and 40°C for 30 days, with 40°C serving as an accelerated ageing condition. Lipid oxidation was assessed at day 1, day 15 and day 30 through four complementary markers covering the full oxidation cascade: peroxide value (PV), Thiobarbituric acid reactive substances (TBARS), p-anisidine value and TOTOX (2*PV+p-anisidine). Colour changes of the powder were monitored.

Compositional analysis confirmed the strong nutritional potential of the freeze-dried liver powder, with 62.6% protein, 26% fat, a favourable omega-3 profile and exceptionally high Vitamin A content (12,600 µg/100g). All groups started from an equivalent fresh oxidation state (TOTOX < 1 at day 1). Temperature emerged as the primary driver of oxidation progression as confirmed through colour analysis where all the livers powders presented a darker colour when stored at 40°C. After 30 days of storage, the livers treated with Tocopheryl-Succinate always presented the lowest oxidation stage compared to the vitamin A and control livers. However, following recommendations regarding acceptable totox levels, only storage at -18°C, allowed for a slower oxidation process of the salmon liver.

Overall, this study showed that liver could be a good source for a complement but needs to be properly pre-treated to prevent the oxidation of the oil and degradation of the benefit over long storage time.

S402 - CRABEX: Sustainable Extraction and Valorisation of European Green Crab Shells for Feed and Food Applications

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The CRABEX project aims to develop and test sustainable extraction technologies for the recovery of proteins, minerals, chitin and astaxanthin from shells of the European green crab (*Carcinus maenas*). The objective is to establish a circular biorefinery approach that converts an underutilised marine biomass into high-value functional ingredients for aquaculture feeds and sustainable nutrient sources for food and health-food applications.

CRABEX is organised as a value-chain collaboration encompassing raw material supply, extraction technology development, process scale-up and feed validation. Green crab shells are provided by Decameal who reasonably developed a method to extract proteins from the crabs for use in aquaculture. The side-stream from that process is the focus for CRABEX and is processed using environmentally friendly extraction technologies at DTU Food. The recovered fractions are characterised with respect to yield, composition and functionality. Process scale-up and pilot production will be performed by the Danish Technological Institute (DTI), while Aller Aqua will evaluate the suitability of the extracted fractions for aquaculture feed applications. In parallel, the project explores the potential utilisation of selected fractions in food and health-food products.

The project is expected to demonstrate the feasibility of recovering multiple valuable components from green crab shells through integrated and resource-efficient processing. By combining extraction and fractionation strategies, CRABEX seeks to maximise biomass utilisation while minimising waste generation. This set-up will be presented and discussed at this year's WEFTA meeting.

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S403 - Effectiveness of natural and synthetic antioxidants in controlling lipid degradation during fish by-product protein hydrolysate production

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Fish by-product protein hydrolysates (FPH) are increasingly used as functional ingredients. However, their production process, which involves moderate temperatures, promotes lipid degradation. This study aimed to evaluate the effectiveness of antioxidants in controlling lipid stability during FPH production from seabass (*Dicentrarchus labrax*), bonito (*Thunnus alalunga*) and salmon (*Salmo salar*) heads.

FPH were produced under constant conditions with carnosic acid-based antioxidants (water- and oil-soluble Bordantix®) and tocopherol-based products (Tocobiol® and Nutrabiol®), applied at two concentrations (0.2 and 0.5%). Negative control and positive control using BHT were included. Lipid degradation was assessed through acid value (AV), peroxide value (PV), thiobarbituric acid reactive substances (TBARS) and anisidine value.

Results showed that carnosic acid-based antioxidants were the most effective in seabass, achieving reductions of up to 60% in TBARS and 40% in anisidine values compared to the control. Tocobiol® showed moderate reductions, whereas Nutrabiol® provided limited protection. BHT reduced secondary oxidation but did not outperform carnosic acid treatments.

In bonito, oxidation was more pronounced and antioxidant performance more variable. Carnosic acid-based formulations reduced oxidation (up to 40% depending on the parameter), although high PV and anisidine values persisted. Tocopherol-based antioxidants offered partial protection, although Nutrabiol® showed poor performance. A clearer dose-dependent effect was observed, with higher concentrations improving stability. BHT was the most effective one, especially on anisidine values.

In salmon, overall oxidation was lower, particularly for secondary products. Tocopherol-based antioxidants showed good performance, achieving reductions of up to 50% in PV and TBARS, while carnosic acid-based treatments also maintained low oxidation levels.

In conclusion, antioxidant selection and dosage are critical to control lipid degradation during FPH production. Carnosic acid-based formulations emerge as promising natural alternatives to synthetic antioxidants for stabilizing FPH and derived fish oils.

F409 - Industrial enzymatic hydrolysis of chicken rest raw materials: effects of process design on protein recovery and product properties

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Valorization of chicken rest raw materials through enzymatic hydrolysis offers an opportunity to recover proteins and lipids for use in feed applications. However, industrial implementation requires knowledge of how processing conditions influence product yield, protein recovery, and functionality. This study investigated the effect of industrially relevant hydrolysis process designs on chicken viscera and bone-rich raw materials.

Eleven hydrolyses were performed using endogenous enzymes, commercial proteases, different water addition levels, pre-inactivation of endogenous enzymes, thermal lipid separation, and varying hydrolysis times. Product fractions including hydrolysates, sediments, lipids, and emulsions were characterized with respect to protein recovery, degree of hydrolysis, amino acid composition, and functional properties.

The results showed clear differences between viscera and bone materials. Viscera exhibited high endogenous proteolytic activity and substantial autolytic capacity, with heating to hydrolysis temperature accounting for a large proportion of the total protein recovered in the hydrolysate. Protein recovery in hydrolysates increased primarily during the first 60 minutes of hydrolysis, whereas degree of hydrolysis continued to increase thereafter. Thermal pre-inactivation of endogenous enzymes shifted protein recovery from hydrolysates to sediments, while reduced water addition decreased hydrolysate protein recovery and degree of hydrolysis. Viscera hydrolysates displayed higher degrees of hydrolysis and superior emulsifying properties, whereas bone-derived products were characterized by higher water-holding and oil-absorption capacities.

These findings demonstrate that raw material characteristics and process design strongly influence protein distribution and product functionality during enzymatic hydrolysis. The work highlights the importance of tailoring hydrolysis conditions to specific chicken rest raw material fractions and emphasizes that both hydrolysates and sediments should be considered valuable products when optimizing industrial biorefinery processes.

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S404 - From Marine Side Streams to Omega-3 Value Chains: Building Knowledge, Capacity and Industry Engagement Through Student-Led Research

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Aim of Research: The project aims to identify and evaluate opportunities for valorization of side streams generated during the production of fish oil and omega-3 concentrates from marine residuals. In addition to improving resource utilization and sustainability, the project seeks to increase knowledge and competence among students, stimulate interest in marine bioprocessing and seafood technology, and strengthen collaboration between academia and industry through co-creation activities.

Methods: The study combines technological mapping, literature review, laboratory analyses, and industry engagement. Key side streams generated throughout the processing chain from fish residuals to omega-3 concentrates were identified and assessed with respect to composition, potential applications, and technological upgrading routes. The work was organized as a co-creation model involving researchers, industry partners, and students. Industrial case studies, company visits, guest lectures, and industry-relevant assignments were integrated into teaching activities to ensure relevance and facilitate knowledge exchange between academia and the seafood sector.

Results and Discussion: The project has demonstrated significant opportunities for upgrading side streams, including spent bleaching earth, crude glycerol, soapstock, and fractions generated during urea fractionation. Several technological pathways were identified for recovering valuable lipids and bio-based products, contributing to a more circular and sustainable utilization of marine resources.

Beyond the technological outcomes, the project has generated substantial educational impact. To date, at least six students have completed their theses within the project, with several additional master projects ongoing. The activities have increased student interest in marine bioprocessing and side-stream valorization, with several bachelor students continuing to do master's studies within the same field. The integration of industrial examples into courses, together with company visits and direct interaction with industry partners, has strengthened the relevance of education and provided students with insight into real industrial challenges. The project thereby contributes to moving the state of the art not only through technological innovation but also through new approaches to competence development and recruitment.

Conclusions: The project demonstrates that side-stream valorization can create environmental, economic, and societal value simultaneously. The findings highlight the potential of marine residuals as sources of high-value products while supporting more sustainable seafood production. Furthermore, the project illustrates how a co-creation model involving academia, students, and industry can accelerate innovation, strengthen knowledge transfer, increase student recruitment, and build competencies needed for the future bioeconomy and seafood sector.

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F410 - Upcycling of Atlantic herring (*Clupea harengus*) side-streams and implications of life cycle assessment goal-statement paradigms. Preliminary findings

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In 2023, inhabitants of the European Economic Area generated a total of 58 million tonnes of food waste with 29% of it associated with primary production, processing and manufacturing. Upcycling side- and streams from the food value chain for human consumption can therefore have a large potential on expanding nutrient availability and improve value retention. However, any change in product utilisation can also cause changes to environmental burdens, nutrient flows and market dynamics. Using life cycle assessment (LCA) methodology one can attain insights into environmental footprints. However, these results are highly sensitive to goal and scope choices, such as, the intended context and intended end use, audience interpretation, functional unit selection, system boundaries and substitution or allocation approaches.

An attributional LCA of two upcycled products - herring oil and herring collagen from filleting cut-offs, was assessed for their required production inputs to develop a life cycle inventory. To evaluate the benefits and challenges that upcycling can cause depending on methodological choices, three goal-statement paradigms were used:

1. Consumer perspectives, evaluating upcycling in accordance with human health and nutrient accessibility.
2. Industrial perspectives, evaluating upcycling in accordance with financial potential and constraints, as well as market changes.
3. Governmental management perspectives, evaluating upcycling in accordance with resource and biomass security.

With these as foundations, the implications of functional units, allocations, and substitution modelling were assessed. Building upon these findings, a material flow analysis (MFA) of herring landed in Norway was integrated with the LCA results to create a scenario analysis to assess the implications of reallocating herring cut-offs from salmon feed to upcycled food alternatives. Tracking nutrient, environmental footprints, product quantities, and purchase-cost proxies.

The preliminary findings show that when measured in mass, almost equal amounts of herring are used for human consumption as for salmon feed, once cut-offs are included in the assessment. Traditional measuring using functional units creates a clear distinction of which products are favorable, however, a novel perspective based on a biomass unit changes the findings and appears more representative across multiple goal-statement paradigms. Similarly, footprint allocation strategies were shown to have a significant effects on the resulting environmental footprint burden of the upcycled products. Furthermore, when assessing the potential benefits of using the cut-offs differently. Production of collagen might entail a higher revenue potential for producers, whereas continued use of herring cut-offs for salmon feed might result in a higher nutrient transfer to consumers.

F411 - Screening the bioactive potential of novel Adriatic Sea streptomycetes for circular blue biotechnology applications

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Streptomyces are ubiquitous saprophytic bacteria renowned for their ability to produce over two-thirds of clinically useful antibiotics, alongside diverse bioactive compounds, including those with anticancer, antiviral, and immunosuppressive properties. In the context of blue biorefineries, marine streptomycetes represent a valuable tool for side-stream valorization due to their enzymatic capacity to degrade organic waste while simultaneously producing high-value secondary metabolites. The aim of this study was to characterize the biodiversity, as well as the inhibitory and hydrolytic potential, of *Streptomyces* strains isolated from various niches in the Adriatic Sea. Over 200 isolates were collected using a selective, salt-supplemented medium optimized for streptomycete growth. 126 strains were confirmed as *Streptomyces* using 16S rRNA and rpoB markers. To evaluate their enzymatic capacity, the isolates were screened for the production of amylase, esterase, lipase, protease, cellulase, and chitinase using specific substrates under various growth conditions. Additionally, their antimicrobial potential was assessed across nine different media and in the presence of various elicitors to account for condition-dependent metabolite production. The screening was conducted against a reference panel including *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Bacillus subtilis*, and *Candida albicans*. Based on these results, 30 isolates were selected for further testing against 15 multidrug-resistant (MDR) clinical pathogens, highlighting methicillin-resistant *S. aureus* (MRSA). Nine isolates showed strong activity against several tested MDR strains. Furthermore, culture supernatants of the four most promising isolates grown in different liquid media showed significant potential to inhibit various clinical pathogens, including MRSA. Finally, considering the isolates with the best hydrolytic and antimicrobial potential, as well as their lower 16S rRNA and rpoB gene sequence similarities to NCBI database entries, six isolates were selected for whole-genome sequencing. Genome assembly, annotation, and antiSMASH analysis confirmed that they represent novel species containing both known and previously undescribed BGCs, as well as numerous hydrolytic enzymes of biotechnological significance. While structure determination of the antimicrobial metabolites is ongoing, their unique metabolic profiles highlight their potential not only for medical applications but also for side-stream utilization. These novel strains could be employed in circular aquaculture and seafood processing to convert low-value marine by-products into high-value bioactive compounds and probiotics, supporting resource-efficient blue biotechnology.

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S501 - Do herring fillets provide sensory benefits in restructured fish products? Evidence from sensory profiling of whole, belly-cleaned, nobbed and filleted Baltic herring fractions

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Aim of research: Improving the utilisation of underused Baltic herring resources requires identifying processing strategies that maximise product value while minimising unnecessary raw material losses. This study evaluated whether increasingly refined herring fractions provide measurable sensory benefits in restructured fish products and whether high-moisture extrusion offers advantages over conventionally processed minced fish products.

Material/methods/design: Baltic herring was processed into four fractions representing increasing degrees of trimming: whole fish, belly-cleaned fish, nobbed fish, and fillets. Following grinding and cutter processing, the materials were manufactured into two product formats: conventionally cooked patties and high-moisture extruded products. Samples were evaluated by descriptive sensory profiling in duplicate using trained assessors (n=8). Complementary instrumental analyses included colour and texture measurements, microscopy, together with microbiological quality evaluation.

Results and discussion: Across both product formats, the largest sensory differences were observed between products prepared from whole-fish and those produced from the more refined fractions. Whole-fish products showed stronger fish-skin and fishy flavour and a browner appearance, whereas products made from belly-cleaned, nobbed and fillet fractions formed a relatively similar sensory group. Multivariate analyses confirmed that whole-fish samples occupied a distinct sensory space, while the trimmed fractions clustered closely.

together. These findings suggest that extensive filleting may provide limited sensory benefit compared with less intensive trimming approaches.

Product format also influenced sensory characteristics. Conventionally processed patties exhibited greater structural heterogeneity, with coarse particles contributing substantially to sample differences. In contrast, high-moisture extrusion produced a more homogeneous texture and largely eliminated hard-particle perceptions associated with the raw material. These results indicate that extrusion can reduce structural defects originating from less refined fish fractions while preserving overall sensory quality.

Conclusions: The results demonstrate that trimming beyond belly-cleaning or nobbing provides limited sensory benefit for restructured Baltic herring products. High-moisture extrusion appears to improve texture uniformity and reduce undesirable particle perceptions, enabling the use of less refined raw materials without major sensory penalties. These findings support more resource-efficient utilisation of Baltic herring and provide guidance for the development of value-added products from underutilised fish resources.

F502 - An Upgraded Concept of Sausage with Biological Activity: Combining Chub Mackerel (*Scomber colias*) and Brown Seaweed (*Fucus sp.*) in a Functional Food

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Aim of research: Marine resources have a large and underexploited trove of bioactive compounds with high potential for functional foods. The valorization of these resources —such as undervalued fish species and seaweed— may bring benefits to human health, considering macronutrients, iodine, selenium, and biologically active compounds. Functional foods may contribute to this resource upgrading, thereby helping in the reduction of disease risk. In order to fully tap this potential, it is important to apply a multidisciplinary approach that includes studies on technological processing, nutritional profiling, compound bioaccessibility, biological activity, and safety. This study presents a case-study, encompassing selection of a Portuguese seaweed and the conception, development, and characterization of a fish-based sausage enriched in seaweed, which uses Atlantic chub mackerel (*Scomber colias*) and a seaweed harvested from the Portuguesec shores (*Fucus sp.*) as functional ingredients.

Material/methods/design: The undervalued fish species, Atlantic chub mackerel (*Scomber colias*), was caught off in Portuguese waters in May 2026 and the brown seaweed *Fucus sp.* was harvested in Peniche (Portugal) in February 2026. The Frankfurt type sausage was reformulated by completely replacing pork meat and fat by mackerel, a fatty fish, and enriched with *Fucus sp.*, being conceived for younger consumers (encompassing children and teenagers) as a healthy and rehabilitated food brand rich in omega-3 fatty acids (mainly EPA and DHA), iodine, and biological activity. Compound analysis (polyphenols, etc.), compounds' bioaccessibility (through the in vitro simulation of the human digestive process), and bioactivities (antioxidant, anti-inflammatory) followed standard IPMA methods. Preparation of the innovative fish sausage comprised addition of usual ingredients and typical processing operations.

Results: While Atlantic chub mackerel is an outstanding source of omega-3 fatty acids, *Fucus sp.* was analysed and high levels of bioactive compounds, including polyphenols, and biological activity (antioxidant and anti-inflammatory) were determined. The seaweed-enriched fish sausage formulation incorporated approximately 3% (w/w) freeze-dried *Fucus sp.* biomass, contained 302.1±26.4 mg GAE/100 g dw as total phenolic content in aqueous extract, and displayed high anti-inflammatory activity in ethanol extract, 70.4±8.6%, thereby comparing favorably to the control fish sausage with 77.3±2.3 mg GAE/100 g dw and 54.6±2.1%, respectively. The bioaccessibility study confirmed these advantages in the bioaccessible fraction of the seaweed-enriched sausage.

Conclusions: The novel fish sausage enriched in *Fucus sp.* showed to possess higher biological activity than the control product and to benefit from the 3% (w/w) incorporation rate of seaweed, thus paving the way to a rehabilitated and healthy food.

F503 - Unlocking the potential of underutilised blue resources

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Aim of research: The objective of this study was to provide evidence-based insights into the valorization of marine resources through the analysis and development of innovative functional food products derived from underexplored marine resources, fisheries by-products and bycatch.

Material/methods/design: *G. gracilis* (red seaweed) was cultivated in an Integrated Multi-Trophic Aquaculture (IMTA) system at AQUALVOR Lda. (Lagos, Portugal) and harvested in April 2024. The brown seaweeds *H. elongata* and *Fucus* sp. were collected along the Portuguese and Spanish coasts in February 2026. Atlantic chub mackerel (*Scomber colias*) was obtained from Portuguese waters in April 2025, either from commercial catches or the retail market. Food prototypes, including seaweed-based nachos, Breton galette, and fish-based sauce, sausages, and hamburger, were developed as healthier alternatives for children, adolescents, and young adults. A multidisciplinary evaluation included nutritional characterization, determination of bioactive compounds (including polyphenols), assessment of bioaccessibility through an in vitro simulation of the oral, gastric, and intestinal phases, and evaluation of antioxidant and anti-inflammatory activities.

Results and discussion: Functional food products were developed using marine ingredients rich in bioactive compounds, including iodine and polyphenols from seaweeds and EPA, DHA, and selenium from chub mackerel (*Scomber colias*). Nutritional characterization confirmed high levels of these compounds, together with significant antioxidant and anti-inflammatory activities, supporting their potential to improve dietary quality and help prevent chronic inflammation-related diseases. Importantly, in vitro gastrointestinal digestion demonstrated high levels of bioaccessible polyphenols and bioactive properties, indicating that the functional potential of the foods was largely preserved after digestion. Representative findings include seaweed-based nachos containing approximately 1% (w/w) *G. gracilis*, which provided about 100 µg of iodine per serving, meeting EFSA's adequate intake recommendations. The nachos also exhibited high phenolic content (412 ± 18 mg GAE/100 g dw), strong antioxidant activity ($2,742 \pm 122$ µmol Trolox Eq/100 g dw), and anti-inflammatory potential (59% COX-2 inhibition).

Conclusions: These case studies demonstrate that the valorization of seaweeds, marine by-products, and underutilized fish species can support the development of innovative functional foods with promising nutritional and bioactive properties. This multidisciplinary approach, grounded in the principles of One Health and the circular bioeconomy, offers a sustainable framework for translating marine biodiversity into commercially viable functional foods that promote health and well-being.

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P101 - Green extraction of nanocellulose from Icelandic seaweed for use as sustainable packaging for seafood

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The Seafoodture project pursues the integral valorisation of seaweed biomass for the development of sustainable food packaging materials. Within this framework, nanocellulose is being produced for use in films and aerogels to extend the shelf life of fish such as salmon and cod. Conventional nanocellulose extraction relies on sodium chlorite (NaClO_2), a carcinogenic oxidising agent that raises serious concerns for both human health and environmental sustainability. This study aimed to develop and optimise a greener extraction methodology capable of producing nanocellulose with comparable physicochemical properties, and to validate its scalability as a viable alternative to chemical-intensive production routes.

Icelandic *Saccharina latissima* biomass was used as raw material. Following a standardised protein extraction step, the delignification and bleaching protocol was redesigned: sodium chlorite treatment was replaced by a two-stage process combining sodium hydroxide (NaOH) treatment with sonication, followed by hydrogen peroxide (H_2O_2) bleaching. Nanocellulose was subsequently produced by ultrasound-assisted extraction. Key process parameters were systematically optimised, including filtration conditions, NaOH concentration, sonication duration, H_2O_2 concentration, extraction temperature and treatment time. Method development followed a stepwise scale-up approach, progressing from milligram-scale extractions toward multi-kilogram seaweed processing. Small-scale parameters have been fully optimised at up to 100 g dry seaweed per batch, while adaptation to larger volumes is ongoing.

At 100 g scale, a 0.25M NaOH solution at a ratio 1:3 (w/v) sonicated for 1 hour effectively removed residual lignin and hemicellulose without degrading the cellulose fraction. Bleaching was achieved by heating the residue at 50°C overnight in a 20% H_2O_2 , followed by a second extraction with 35% H_2O_2 for 4 hours. Ultrasound assisted extraction at 0.5% consistency, 70 W, and 70% amplitude for 15minutes (30s on /1min off) yielded optimal nanocellulose quality. Final characterisation of the produced nanocellulose is currently underway.

This study demonstrates that a greener extraction pathway for nanocellulose from *Saccharina latissima* represents a scalable alternative to sodium chlorite–sulfuric acid routes, eliminating carcinogenic and highly corrosive compounds while preserving nanocellulose quality. The ongoing scale-up work provides a credible foundation for sustainable bio-based packaging production within the seaweed industry.

P102 - Invasive algae: threat or opportunity?

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The extent and significance of invasive seaweed species in marine ecosystems have dramatically increased in recent years and have been recognised as one of the main causes of biodiversity loss and changes in native populations, community dynamics, and major ecosystem processes. Controlling invasive seaweeds requires a multifaceted approach, as total eradication is highly challenging once they are established. The European Union has a framework to tackle the issue (EU Regulation 1143/2014), which prioritises preventing the introduction of non-native species and, where possible, their eradication. However, promoting the commercial exploitation of these species is also being presented as a management and control option. In this context, we present an overview of the risks and benefits of the commercial exploitation of invasive algae, based on scientific evidence and case-study analysis. Different invasive seaweed species have been identified in Europe; among them, *Sargassum muticum*, *Undaria pinnatifida*, and *Rugulopteryx okamurae* are considered the most relevant due to their ecological and socioeconomic impacts. In general, these brown seaweeds are considered a good source of bioactive compounds and polysaccharides, such as fucoidans, alginate and laminarin. For this reason, despite their invasive nature, scientific studies have reported interest in their use in agricultural, aquaculture, nutraceutical, functional food, biomaterial, or energy applications. However, turning invasive species into commercial products may create incentives to maintain them, rather than eradicate them. The scientific consensus claims that the use of invasive algae can be sustainable only when it is designed as a part of management and eradication programs, and emphasises that the biomass must come exclusively from authorised harvesting activities. In this context, commercial initiatives must be designed to avoid providing economic incentives for the cultivation, maintenance, or propagation of invasive species, thereby ensuring that biodiversity conservation remains the primary objective.

P103 - Seasonal and geographical variation in the biochemical composition of Arctic seaweeds over a yearly cycle

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Background/Aim of study: To make a robust algae industry in Norway it is important to collect information about several species, to know which ones are most likely to have the best utilisation potential. Most existing data on seaweeds are on temperate and tropical species. The light and temperature conditions in the Arctic are very special, and composition of Arctic species might not be comparable to these. The aim of this study was thus to document how light, temperature and other physical conditions affect biochemical composition in Arctic seaweeds over a year.

Materials/methods/design: During one full year we monitored 6 common Arctic seaweed species at 4 different growth sites within one hour drive from Bodø, each having different physical traits regarding wind/wave exposure, salinity, nutrient availability etc. Algae samples were harvested once every month from the intertidal zone at low tide, cleaned from epiphytes, frozen and freeze dried. The freeze-dried samples were analysed for proximate composition (water, ash, lipid and protein contents). During each sampling, a seawater sample was taken from each site to measure salinity and dissolved nutrients. Climate data were also registered at the sampling times.

Results and discussion: *Saccharina latissima* and *Fucus vesiculosus* were found at all four harvesting sites. *Ascophyllum nodosum* and *Alaria esculenta* was found at three sites, *Palmaria palmata* at two sites and *Ulva spp.* at only one site. Most of the species could be harvested throughout the year on at least one of the harvesting sites, the exceptions being *Alaria esculenta* and *Ulva spp.* which were not found during late autumn/early winter. As expected, proximate composition variation in all species followed more or less the same pattern, but with different amplitude, depending on temperature and light conditions. There was, however, considerable within-species variation between different harvesting sites at the same sampling time, highlighting the importance of physical growth factors, such as wave and wind exposure, nutrient availability and salinity.

Conclusions: Presence, growth and biochemical composition of Arctic seaweeds vary over a yearly cycle. The growth location seems to have larger impact on the biochemical composition than earlier believed due to physical conditions. This information may be useful for choice of species and aquaculture locations for future algae industry in Norway.

P104 - Comparative Characterisation and Bioactivity Assessment of Phlorotannins from Adriatic Brown Macroalgae of the Genus *Ericaria*

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Aim of research: Brown macroalgae are known for their high concentrations of phlorotannins, a type of polyphenol with a variety of biological functions. However, evidence on phlorotannins from Adriatic species of the *Ericaria* genus is scarce. The purpose of this research aimed to isolate phlorotannin-rich fractions from *Ericaria crinita*, *Ericaria mediterranea*, and *Ericaria amentacea*, characterize their chemical profile, and assess their antioxidant and neuroprotective properties.

Materials/methods/design: Lyophilized biomass was extracted with 80% ethanol (1:10, w:v), and phlorotannin-enriched fractions were isolated by C18 solid-phase extraction. The fractions were concentrated and reconstituted in 50% methanol. Chemical characterization was performed by UHPLC-ESI-HRMS analysis. Total phenolic content (TPC) and phlorotannin content were determined using Folin-Ciocalteu (F-C) and 2,4-dimethoxybenzaldehyde (DMBA) assays. Antioxidant activity was evaluated by 2,2-diphenyl-1-picrylhydrazyl-hydrate (DPPH) and 2,2'-azinobis-(3-ethylbenzothiazoline-6-sulfonate (ABTS) assays. Neuroprotective potential was investigated through monoamine oxidase A and B (MAO-A, MAO-B) inhibition assays.

Results and discussion: Significant inter-species variations were observed among the investigated macroalgae. *E. amentacea* exhibited the highest TPC (F-C: 20.17 g PGE/100 g fraction; DMBA: 1.31 g PGE/100 g fraction). UHPLC-ESI-HRMS analysis further confirmed the highest content of phlorotannins in *E. amentacea*, even though *E. crinita* has the highest number of individual phlorotannins, accounting for 15 (7 in *E. mediterranea*, 10 in *E. amentacea*). Monomers and small dimers, eckols and phlorotannins with the degree of polymerisation 3-5 are the most abundant in *E. amentacea*, while phlorotannins with higher degree of polymerisation 6-12 are present only in *E. crinita*. *E. amentacea* also showed the strongest antioxidant activity, with DPPH and ABTS IC₅₀ values of 0.09 and 0.06 mg/mL, respectively. Furthermore, *E. amentacea* demonstrated pronounced inhibition of MAO-A (91.21 %) and moderate inhibition of MAO-B (54.66 %), indicating notable neuroprotective potential. *E. crinita* and *E. mediterranea* exhibited lower phenolic contents and weaker biological activities. The observed bioactivities were generally consistent with the measured phlorotannin levels, suggesting that these compounds significantly contribute to the antioxidant and enzyme inhibitory properties of the investigated fractions.

Conclusions: Phlorotannin-enriched fractions derived from Adriatic *Ericaria* species represent a promising reservoir of natural bioactive chemicals. Among the examined species, *E. amentacea* had the most beneficial chemical profile as well as the strongest antioxidant and neuroprotective potential. These findings encourage additional research into Adriatic brown macroalgae as sustainable resources for functional food, nutraceutical, and biotechnological uses.

P105 - Optimization of *Chlamydomonas reinhardtii* Cultivation Conditions: Effects on Growth Performance

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The green microalga *Chlamydomonas reinhardtii* is a commonly used model organism with growing biotechnological potential. Therefore, optimizing cultivation conditions is crucial for enhancing biomass productivity and establishing a cost-effective cultivation process. This study evaluated the effects of culture medium and LED illumination on the growth of the green microalga *C. reinhardtii* over 14 days.

Cells were cultivated at 25 °C in three media: Bold's Basal Medium (BBM), Modified Bold's Basal Medium supplemented with threefold nitrogen and vitamins (3N-BBM+V), and Jaworski's medium. Cultures were exposed to either continuous warm white light (WWL) or a combination of red and blue light (RBL). Growth was monitored by cell counting and spectrophotometric measurements. Afterwards, specific growth rates and generation times were calculated.

Warm white light consistently promoted higher growth than red–blue light across all media. The highest cell density and specific growth rate, together with the shortest generation time, were achieved in 3N-BBM+V under WWL. In contrast, Jaworski's medium produced the lowest biomass regardless of illumination. The superior performance of 3N-BBM+V is likely due to its increased nitrogen and phosphorus content, with phosphorus playing a particularly important role in supporting cellular metabolism and growth.

Although previous studies have reported inconsistent responses of *C. reinhardtii* to different light wavelengths, these differences are likely attributable to strain-specific characteristics and cultivation conditions. Our findings indicate that warm white light is more effective than red–blue light for the tested strain under the applied conditions.

Overall, both medium composition and illumination significantly influenced *C. reinhardtii* productivity. Cultivation in 3N-BBM+V under warm white LED illumination (3,800 lx) provided the most favorable conditions for biomass production and represents a promising strategy for pilot-scale cultivation. These results highlight the importance of optimizing multiple cultivation parameters simultaneously to maximize microalgal growth and support the efficient production of valuable bioproducts.

P106 - Seasonality and geography as factors affecting lipid fraction and anti-inflammatory activity of the invasive seaweed *Rugulopteryx okamurae*

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Aims & research: The invasive brown seaweed *Rugulopteryx okamurae* is a major problem in Southwest Europe. This seaweed belongs to the Family Dictyotaceae, originating from the Pacific Ocean. Its expansion in the Western Mediterranean and Portuguese Southern Coast has been characterized by intense blooms. The biomass of *R. okamurae* may have economically relevant components and biological activities. Given this major challenge, it is important to investigate and find out whether seasonality (Winter vs Summer) and specific geographic location (Mediterranean Sea vs Atlantic Ocean) have an influence upon some features of the algal biomass.

Material/methods/design: Samples of *R. okamurae* were collected in the Málaga region (Mediterranean) at two locations, Benalmádena (April 2023 and 2024, November 2024) and Manilva (November 2023), and in Algarve (Atlantic) at Lagos (October 2024). Samples were sorted in accordance with their location and past growing season. Total lipid extraction was carried out according to the Bligh and Dyer method, lipid classes were analysed by High-Performance Thin-Layer Chromatography, and fatty acid (FA) profile was determined by gas chromatography after acid catalyzed transesterification. The anti-inflammatory activity in the extracts from *R. okamurae* was analysed through an enzymatic methodology based on the inhibition of the cyclooxygenase-2 (COX-2).

Results & discussion: The FA profile revealed prevalence of palmitic acid and saturated FA (SFA) in all lipid classes. Lipid class distribution in *R. okamurae* was characterized by a majority of polar lipids, with non-polar lipids making up to 40% of the total lipid content. Within polar lipids, glycolipids were the main class and monogalactosyldiacylglycerols (MGDG) had a share ranging from 45 to 58% of the total lipids. The SFA content ranged between 30.8±1.3% (of total FA) in Atlantic (Algarve) *R. okamurae* MGDG and 82.5±2.6% in Atlantic *R. okamurae* phospholipids. The FA profiles of *R. okamurae* from the two studied locations had similarities, differing in palmitic acid content in triacylglycerols (TAG), oleic acid in MGDG, PUFA in digalactosyl diacylglycerols (DGDG), and n-3/n-6 ratio in MGDG. Regarding this latter parameter, the highest n-3/n-6 ratio was in Algarve MGDG samples, 1.8±0.1. The anti-inflammatory activity by the COX-2 assay showed higher levels of this parameter in Summer *R. okamurae*, 68.3-78.5% COX-2 inhibition, than in Winter *R. okamurae*, 58.0-65.9% COX-2 inhibition.

Conclusion(s): *R. okamurae* exhibits some distinctive traits according to geography and season and there is a potential valorization by component isolation (e.g. MGDG) and further refining of biologically active fractions.

P107 - Application of *Ascophyllum nodosum* processing side-stream in reduced-salt 3D printed surimi: effects on printability and functional properties

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Reduced-salt surimi presents challenges for extrusion-based 3D food printing because lowering the salt content can comprise protein solubilization, gel formation, and structural integrity. This study examined the impact of using *Ascophyllum nodosum* press liquid extract, a seaweed-processing side-stream, as a salt-reducing agent on the printability and quality attributes of 3D-printed surimi gels. Four surimi formulations containing 0, 0.125, 0.25, and 0.5% *A. nodosum* extract were prepared using a surimi base containing a D-allulose cryoprotectant system (4% sorbitol and 4% D-allulose, 1:1, w/w) and fixed NaCl concentration of 0.5%. The formulations were 3D printed and steam cooked, and their dimensional stability, gel strength, cooking loss, texture, color, water characteristics, sensory characteristics, and total phenolic content were evaluated. Incorporation of *A. nodosum* extract enhanced dimensional stability during steam cooking and increased gel strength. and cooking loss decreased, while hardness, gumminess, chewiness, and resilience increased. Low-field Nuclear Magnetic Resonance (LF-NMR) analysis showed shorter T_2 relaxation times with increasing extract concentration, indicating increased water restriction within the gel matrix. The seaweed extracts also slightly diminished lightness and increased yellowness, particularly after cooking. Sensory evaluation showed reduced fish-ball odor and flavor intensity and increased softness, with slight off-flavor perception at the highest concentration. Total phenolic content (TPC) increased concentration dependently, attaining 11.19 g PGE/100 g at 0.5% extract concentration. Overall, the *A. nodosum* press liquid extract improved several structural, water-retention, textural, and phenolic characteristics of reduced-salt 3D printed surimi. However, extract concentrations should be optimized to balance technological functionality with color and sensory quality of the surimi.

P201 - Effects of chitosan concentration and rosemary extract level in edible coatings on the quality and shelf life of MAP-packaged sardines

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Aim of research: The aim of this study was to evaluate the effectiveness of chitosan-based edible coatings containing different concentrations of rosemary extract, applied in combination with modified atmosphere packaging (MAP), for preserving the quality and extending the shelf life of refrigerated sardines.

Materials/methods/design: Edible coatings were formulated using three chitosan concentrations (0.5, 0.75 and 1.0% (w/v)) and three rosemary extract concentrations (20, 50 and 80% (v/v)), resulting in nine coating formulations. Whole sardines were coated, packaged under modified atmosphere conditions and stored under refrigeration. Untreated and MAP-packaged samples served as controls. Quality changes during storage were monitored using the Quality Index Method (QIM), lipid oxidation (TBARS), proteolytic index determination and microbiological analyses. Statistical significance was evaluated by one-way ANOVA and Tukey's test ($p < 0.05$).

Results and discussion: All coating formulations contributed to improved quality preservation compared with the untreated control. According to QIM modelling, the estimated shelf life increased from 8.3 days in untreated sardines to 9.4–10.9 days in coated samples, corresponding to an extension of up to 31%. The longest predicted shelf life was achieved using coatings containing 0.75% (w/v) chitosan combined with 20 or 50% (v/v) rosemary extract. Coated samples also showed lower rates of lipid oxidation and proteolytic degradation during storage than untreated fish. Microbiological analysis revealed the most pronounced treatment effect. While aerobic mesophilic bacteria reached 8.1×10^6 CFU g⁻¹ in untreated sardines by day 8, coated samples maintained substantially lower counts throughout storage, generally remaining within the 10^3 – 10^4 CFU g⁻¹ range even after 10 days. Several formulations, particularly those containing higher rosemary extract concentrations, exhibited strong and sustained inhibition of microbial growth.

Conclusions: The combination of chitosan-based edible coatings and MAP effectively delayed spoilage processes in refrigerated sardines by reducing microbial growth and slowing quality deterioration. The results demonstrate that optimizing the concentrations of chitosan and rosemary extract can significantly improve product stability and extend shelf life. This preservation strategy represents a promising, sustainable alternative for enhancing the quality and safety of fresh fish products.

Funding: The research was funded by the Croatian Science Foundation as part of the project IP-2022-10-1837 "Sustainable concept in ACTIVE edible COatings development for shelf-life extension of fresh Adriatic FISH".

P202 - KTP Case Study: New England Seafood International & University of Lincoln Transforming Industrial Seafood Thawing Through Science-Led Innovation

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Aim of Research: This case study describes a 24-month Knowledge Transfer Partnership between New England Seafood International and the University of Lincoln, aimed at modernising and optimising industrial thawing of frozen seafood raw materials. The objective was to develop a more controlled, energy-efficient and science-led thawing strategy to improve process consistency, product quality, yield and operational performance.

Methods: The project combined industrial process mapping, thermal characterisation, airflow analysis and process redesign. Block-frozen fish were assessed under different loading and seasonal conditions to identify causes of non-uniform thawing, long cycle times, temperature gradients and dehydration. The work also included development of improved operating parameters, rack-loading strategies, temperature-control logic and simplified operator procedures. A multi-criteria assessment was used to identify future thawing technologies with industrial potential.

Results and Discussion: The study identified key limitations in the existing thawing process, including uneven thawing, large surface-to-core temperature gradients, high energy demand, seasonal sensitivity and limited process predictability. The redesigned approach improved process control by introducing clearer raw-material-specific set-points, improved loading strategies and simplified monitoring requirements. The project also developed a technology roadmap in which wave-assisted thawing, combined with selected non-wave technologies, was identified as a promising route for improving thawing uniformity, reducing cycle times and supporting scalable industrial implementation.

Conclusions: The case study demonstrates how science-led process engineering can support industrial innovation in seafood thawing. Improved understanding of heat transfer, airflow and raw-material behaviour can help reduce variability, improve product quality and support more sustainable seafood processing. The KTP model also provided an effective framework for knowledge transfer between academia and industry.

P301 - Boosting the environmental traceability of the Atlantic seafood sector - Sea to fork transparency and consumer engagement

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The Atlantic seafood sector is vital to the region's economy, culture, and food security but faces increasing challenges in ensuring environmental sustainability, traceability, and transparency. Although progress has been made, fragmented data systems, limited interoperability, and the lack of harmonized digital infrastructures continue to hinder information exchange across seafood value chains. These limitations reduce transparency, facilitate food fraud, weaken environmental management, and undermine consumer trust.

The project SMART4SEA addresses these challenges by developing an innovative environmental traceability framework that integrates advanced digital technologies to improve transparency, sustainability, and communication with consumers. The project focuses on detecting seafood fraud, reducing the environmental impacts of fisheries and aquaculture, minimizing marine litter, and improving resource efficiency.

While seafood labels currently provide information such as commercial and scientific species name, production method, fishing area, and origin; environmental impacts remain largely absent. SMART4SEA will bridge this gap by integrating Life Cycle Assessment (LCA) with digital traceability tools. Traditional LCA approaches rely on time-consuming data collection and generalized datasets that often fail to reflect regional production practices. By combining Blockchain, Internet of Things (IoT), and real-time data collection, the project will create a comprehensive life cycle inventory database that improves the accuracy, transparency, and credibility of environmental assessments. Data collected from fishing vessels and other supply chain actors will be integrated into a "360° traceability view," enabling the calculation of indicators such as carbon and water footprints, eutrophication, ecotoxicity, organic waste generation, and a novel plastic footprint metric. Blockchain will ensure secure, transparent, and reliable information sharing among all stakeholders.

A key objective is to empower consumers with trustworthy environmental information that supports informed purchasing decisions. Growing consumer demand for sustainable seafood has been accompanied by confusion regarding the reliability of existing eco-labels. SMART4SEA will develop a digital platform providing accessible information on the environmental footprints of seafood products, nutritional value, waste valorization opportunities, and plastic generation throughout the supply chain. The platform will be developed with the active involvement of producers, processors, retailers, restaurants, and consumers to ensure its relevance and usability. Ultimately, SMART4SEA will deliver an integrated digital infrastructure that strengthens traceability, supports data-driven environmental management, and enhances transparency across Atlantic seafood value chains. Through collaboration among ten partners from four Atlantic countries, the project will promote innovation, knowledge exchange, and scalable solutions that contribute to a more resilient, competitive, and sustainable blue economy.

Work funded by the Interreg Atlantic Area programme (EAPA 0146/2024).

P302 - From chicken rest raw materials to aquafeed ingredients: production of protein hydrolysates and evaluation in Atlantic salmon feeding trials

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The aquaculture industry requires sustainable protein sources to reduce pressure on limited marine resources while maintaining fish performance and health. Chicken processing generates substantial volumes of protein-rich rest raw materials, including viscera and bones. These materials can be valorized through enzymatic hydrolysis, producing protein hydrolysates with high digestibility and nutritional value that may serve as alternative feed ingredients.

In this project, chicken rest raw materials were processed through industrially relevant enzymatic hydrolysis to produce protein-rich hydrolysates. The hydrolysates were characterized for nutritional and functional properties and subsequently evaluated as ingredients in Atlantic salmon (*Salmo salar*) feeds. Two feeding trials were conducted: a small-scale screening trial designed to assess digestibility, growth performance, and biological responses, and a larger production-scale trial evaluating the practical application of chicken-derived protein ingredients under commercial aquaculture conditions.

The feeding trials investigated the effects of dietary inclusion of chicken hydrolysates on growth performance, feed intake and intestinal health of salmon. The study provides a comprehensive approach linking raw material valorization, ingredient production, and biological evaluation in fish.

The results demonstrate the potential of enzymatically hydrolyzed chicken rest raw materials as circular feed ingredients for aquaculture and contribute to improved utilization of underexploited animal resources. By connecting hydrolysis technology with feeding performance, the project supports the development of more sustainable and resource-efficient aquafeed production.

P303 - Environmental impacts on land-based salmon farming in Iceland

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Aim: Salmon farming has a low feed conversion ratio and provides high-quality protein with relatively low environmental input. In Iceland, production is currently 45,000 tonnes annually and is projected to reach 245,000 tonnes by 2033, over 30% of which is expected from land-based systems. This study assessed the potential environmental impacts of land-based Atlantic salmon farming

Method: An attributional Life Cycle Assessment (LCA) study was conducted with a functional unit of 1 tonne of salmon produced in land-based systems in Iceland in 2021. A sensitivity analysis tested four electricity mix scenarios: the default Ecoinvent Icelandic electricity mix (baseline), an LCA-based Icelandic energy mix (scenario 1), the residual mix accounting for Guarantees of Origin (GOs) certificates (scenario 2), and the Ecoinvent European mix (scenario 3). Moreover, the potential avoided burdens of upcycling the fish manure into organic fertilizer as a synthetic fertilizer replacer were tested.

Results: For the baseline scenario, impacts per functional unit were: 1.4 t CO₂ eq (Global Warming Potential), 8 kg SO₂ eq (Terrestrial Acidification), 0.6 kg P eq (Freshwater Eutrophication), 582 m²a crop eq (Land Use), and 8659 m³ world eq (Water Scarcity Footprint). These results reflect relatively low environmental burdens compared to similar studies in other countries, largely due to Iceland's renewable energy. However, results from scenario 3 in the sensitivity analysis led to a GWP increase by 377%, due to its large fossil-based composition.

Conclusion: These results emphasize the importance of energy sourcing in shaping environmental outcomes and can guide impact reduction strategies for future land-based salmon farming in Iceland. This work is available as an open access article: <https://doi.org/10.1016/j.aquaculture.2025.743461>

P304 - Is renewing Icelandic demersal trawling vessels resulting in lower greenhouse gas emissions?

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Aim: Demersal trawling is among the most fuel-intensive fishing methods, and vessel renewal is often cited as an important climate mitigation measure. Between 2000 and 2022 the Icelandic bottom trawler fleet was halved, from 84 to 42 vessels, as newer vessels replaced older ones. This study assessed whether renewing Icelandic demersal trawlers has resulted in lower greenhouse gas (GHG) emissions.

Method: A Life Cycle Assessment (LCA) following ISO 14040/14044 was conducted with a functional unit of 1 kg of demersally trawled fish at landing. First-hand fuel and catch data were collected for 11 bottom trawlers from four Icelandic seafood companies over 2012–2022, including four cases where an older vessel was replaced by a new one. Global Warming Potential (GWP100a) was calculated using mass allocation as the base case, with economic allocation tested as a scenario for the edible part. Multivariable regression was used to test the influence of catch, vessel age, size, gross tonnage and fishing zone.

Results: GHG emissions ranged on average from 0.5 to 1.0 kg CO₂ eq per kg of fish landed. They varied with trawler, year and catch composition, and redfish had generally the highest emissions, explained by the low yield of utilization of its side-streams. Fleet renewal alone did not explain the reduction in fuel use and GHG emissions; two of the new vessels used slightly more fuel than the vessels they replaced. Catch composition, fishing ground and vessel characteristics explained 87% of the variation in emission, and 94% using linear regression model. Freezer trawling was more energy-intensive than landing chilled or superchilled catch, and catching consumed more fuel than steaming. Per kg of edible part, emissions reached 2.7 kg CO₂ eq for redfish, reflecting its low utilisation ratio (35% compared with 87% for cod).

Conclusion: Vessel renewal alone is not a sufficient mitigation strategy for bottom trawl fisheries. Newer trawlers bring clear benefits in catch quality and working conditions for the crew, but their additional onboard equipment for catch handling, chilling and by-product utilisation also increases energy use. Emission reductions therefore require a comprehensive approach that considers catch composition, fishing grounds, onboard processing and vessel design, while higher utilisation of side-streams can further lower emissions per kg of food. The full study has been published open access in the Journal of Cleaner Production: <https://doi.org/10.1016/j.jclepro.2024.144245>

P401 - Bioprospecting and valorization of Atlantic cod (*Gadus morhua*) heads from the Norwegian seagoing fleet

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Aims of research: This PhD project aims to highlight the potential of increasing the economic value of the raw materials from the Norwegian seagoing fleet. The research consists of three interconnected projects, targeting the two essential challenges, the economic value of the raw material and the space limitations on board.

The Norwegian seagoing fishing fleet generates more than 110,000 tonnes of rest raw material annually, yet only 43% is landed and utilized. The low utilization rate is primarily driven by the limited economic value of the raw material and the restricted processing and storage capacity onboard fishing vessels. Increasing the value of these side streams is therefore essential to improve their recovery and utilization.

Enzymatic hydrolysis is a promising valorization technology that converts underutilized marine biomass into high-value products for the food, nutraceutical, and pharmaceutical industries. By selecting appropriate enzymes and processing conditions, the technology enables fractionation of lipids, proteins, and bones while tailoring the hydrolysate towards specific end products. Cod (*Gadus morhua*) heads are used as a model raw material due to their high availability and ease of collection, which gives it significant potential for realization.

Methods/design: The first project investigates how different onboard processing methods influence storage efficiency and the quality of subsequent enzymatic hydrolysis, with the aim of identifying processing potential strategies that maximize both onboard storage capacity and downstream product value.

The second project applies bioassay-guided bioprospecting to identify novel bioactive compounds from cod head hydrolysates. The workflow combines enzymatic hydrolysis with in vitro bioactivity screening, chromatographic fractionation, mass spectrometry, simulated gastrointestinal digestion and bioavailability analysis.

The third project focuses on the remaining bone fraction after enzymatic hydrolysis by developing solvent- and salt-free collagen extraction methods, targeting sustainable production of high-quality collagen with potential for gelatin production.

Results/discussion: The processing methods differed in storage efficiency, with some allowing approximately half a cod head more to be stored per unit volume. However, increased processing also resulted in more blood and bone particles in the hydrolysates. Bioassay-guided bioprospecting identified strong antioxidant capacity, but also discovered bioactive peptides against a lifestyle-related disease with pharmaceutical relevance. High-quality collagen was successfully extracted from the bone fraction, although at the expense of extraction yield.

Conclusion: Together, these studies aim to establish a comprehensive valorization strategy for cod heads by increasing their economic value, promoting full utilization of marine side streams, and supporting a more sustainable and circular Norwegian seafood industry.

P402 - Using sea bream by-products to produce new crackers: A sustainable approach for human nutrition

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Given the fundamental importance of sustainability and the excellent nutritional profile of marine resources, the substantial volume of fish by-products generated represents a highly valuable, underutilized resource for human consumption. This research study aimed to develop new crackers using by-products from the filleting of sea bream (*Sparus aurata*). For this purpose, fish by-product meal was prepared using bones, attached muscle and tail. Different formulations of crackers were developed, varying the type and quantity of ingredients (corn flour, by-product meal, olive oil, water, baking soda, xanthan gum and salt). Finally, six formulations were evaluated, the only difference between them was the amount of corn flour and by-product meal. One of the samples was prepared without by-product meal (control sample, C) and the other five were prepared by replacing corn flour with by-product meal at different percentages: 5 % (F5), 10 % (F10), 15 % (F15), 20 % (F20) and 30 % (F30). A sensory analysis was carried out by a semi-trained panel comprising FoodUPV staff, with the aim of determining by consensus whether the formulations had potential to be accepted by consumers. The sensory panel determined that sample F30 had a soft texture that was not suitable for a cracker; therefore this formulation was ruled out for the rest of study. Among the formulations containing by-product meal, the texture of F5 was the hardest, and as the percentage of sea bream by-product meal increased, this parameter decreased; however, even in F20 the texture was acceptable, as was the crispiness. The flavour also was good in all these samples. Therefore, according to the panellists, all the formulations (except for F30) exhibited suitable organoleptic properties. Considering these results, sample F5 was also ruled out, as the substitution percentage was too low, and the aim of this study was to include as much fish by-products as possible. The physico-chemical analyses carried out on samples C, F10, F15 and F20 revealed an increase in ash content as the percentage of by-product meal increased, ranging from 4.8 g/100 g in the control sample to 9.9 g/100 g in F20, due to the high mineral content of the sea bream by-product meal. This study has demonstrated that the formulations of crackers incorporating fish by-product meal could have good market potential, thereby reducing the waste produced in the sea bream processing industry and improving the nutritional quality of the crackers.

P403 - Turning a Defect into Value: Antioxidant and Antimicrobial Potential of Muscle Hydrolysates and Exoskeleton Melanins from Melanosis-Affected Shrimp

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Shrimp (*Litopenaeus vannamei*) is one of the most widely produced aquatic species worldwide, generating large volumes of by-products. A significant proportion of the harvest is discarded due to melanosis, an enzymatic browning that produces black spots on the cephalothorax, abdomen and tail. Although melanosis poses no risk to consumer health, it is treated as a commercial defect, leading to substantial food waste and an opportunity to valorise this raw material as a source of bioactive compounds within a circular economy approach.

This study aimed to evaluate the antioxidant and antimicrobial properties of two fractions from melanosis-affected shrimp: a protein hydrolysate from the muscle (obtained with Alcalase® and freeze-dried) and melanin extracted from the exoskeleton (via demineralisation and deproteinisation with HCl/NaOH, followed by acid precipitation at pH 1.8, dialysis and freeze-drying). Antioxidant capacity was assessed by DPPH and ABTS assays, and antimicrobial activity by broth macrodilution against *Listeria monocytogenes* (CECT 932), *Salmonella Typhimurium* (WT 9104), *Escherichia coli* (CECT 4783) and *Staphylococcus aureus* (CECT 4459), at concentrations from 75 to 4 mg/mL.

Melanin extracts showed markedly higher DPPH activity ($2,433 \pm 83.4$ mg TE/mL) than the muscle hydrolysate (108.5 ± 14.9 mg TE/mL), with a relevant total phenolic content (33.5 ± 0.7 mg gallic acid equivalents/mL). ABTS values were more similar between fractions (melanin: 65.5 ± 0.7 ; hydrolysate: 58.5 ± 0.7 mg TE/mL), showing that both by-products retain antioxidant capacity, although melanin displayed a stronger DPPH response. The hydrolysate showed no inhibitory effect on any of the four bacterial strains tested. Melanin did not fully inhibit growth either, but a decrease in optical density was observed relative to the control, prompting a complementary growth kinetics assay by broth microdilution. The resulting curves confirmed an extended lag phase and less pronounced growth slopes with melanin, particularly at higher concentrations (75 and 37 mg/mL), suggesting a concentration-dependent delay in growth dynamics rather than full inhibition.

These findings indicate that exoskeleton-derived melanin is a promising natural antioxidant, with markedly higher radical scavenging capacity than the muscle hydrolysate, and shows a mild delaying effect on bacterial growth worth further investigation. The hydrolysate, while less potent and without antimicrobial activity, still represents a valuable protein fraction for valorisation. This work supports recovering both muscle and exoskeleton from melanosis-affected shrimp as a viable strategy to obtain functional bioactive ingredients within a circular economy framework.

P404 - Consumer acceptance of food upcycling: cross-country insights from the Up4Food CAWI survey

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Aim of research: Food upcycling is increasingly discussed as a way to reduce food waste and improve the sustainability of food systems. One promising direction is the use of nutrients recovered from food-processing side-streams in new food concepts. However, the market potential of such solutions depends not only on technological feasibility, safety and regulation, but also on consumer acceptance.

Material/methods/design: This study presents results from a CAWI survey conducted within the Up4Food project among consumers in five European countries: Norway, Ireland, France, Poland and Romania. The total sample covered 5,077 respondents, with approximately 1,000 participants per country. The survey examined attitudes towards the idea of using nutrients recovered from side-streams in new food products. Consumers evaluated eight model food concepts based on side-streams from oil production, potato processing and fish processing, including herring and mackerel. The concepts represented different potential applications of recovered nutrients in fortified foods and were used to assess not only general attitudes towards food upcycling, but also differences in acceptance depending on the source of the ingredient and the type of final product.

Results and discussion: The results show that the idea of food upcycling is generally met with moderate but promising acceptance. Ireland and Norway showed the most favourable response patterns. In Ireland, acceptance was consistently high across the tested concepts, while in Norway the strongest support was observed for concepts using nutrients recovered from fish-processing side-streams. France and Poland showed more cautious attitudes, especially towards ingredients of fish origin, whereas Romania occupied an intermediate position, with relatively balanced assessments across the tested concepts.

Conclusions: The study confirms that consumers are open to the idea of upcycled food, but their acceptance is conditional. For food processors, including the fish-processing sector, these results underline the importance of developing product concepts in which sustainability, health benefits, sensory quality and understandable communication are combined from the earliest stages of innovation.

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P501 - Effects of an Octopus-Based Diet With or Without Tea Supplementation on Serum Biochemical Parameters in Mice

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Aim: To evaluate the effects of an octopus-based diet, with or without tea supplementation, on serum biochemical parameters related to lipid, glucose, hepatic, and renal metabolism in mice.

Materials and Methods: Male and female mice CD1 were allocated to three dietary groups (n=8 per group): standard laboratory diet (control), octopus-based diet, and octopus-based diet supplemented with tea. Experimental diets consisted of baked biscuits in which the protein source of the standard laboratory diet was replaced with musky octopus (*Eledone moschata*), while maintaining a nutritional composition comparable to the control diet. Animals were maintained under standard housing conditions and fed ad libitum throughout the experimental period. At the end of the study, serum biochemical parameters related to lipid metabolism (total cholesterol and triglycerides), glucose metabolism (glucose), renal function (urea, creatinine, and uric acid), liver function (AST, ALT, alkaline phosphatase, GGT, and total bilirubin), and iron status were determined.

Results: Diet significantly influenced several metabolic parameters. Compared with control animals, mice fed the octopus-based diet exhibited lower triglyceride concentrations in both sexes. This effect was also observed in mice receiving octopus plus tea supplementation. Total cholesterol levels were lower in octopus-fed males than in controls, whereas tea supplementation was associated with higher cholesterol concentrations than the octopus-only diet in both sexes. No consistent effect of diet on serum glucose concentrations was observed. Urea concentrations showed a tendency to decrease in animals receiving octopus-containing diets. Sex-related differences were also observed. Females generally exhibited lower cholesterol and triglyceride concentrations than males, indicating sex-dependent differences in the lipid response to the dietary interventions.

Conclusions: These findings suggest that an octopus-based diet may beneficially influence lipid metabolism in mice, whereas tea supplementation did not confer consistent additional metabolic benefits. The observed sex-dependent differences highlight the importance of considering biological sex in nutritional intervention studies.

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P601 - Seasonal and Spatial Variation in the Biotechnological Potential of the Gastropod *Vermetus triquetrus*

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Aims & research: The sessile vermetid gastropod *Vermetus triquetrus* remains an underexplored marine resource. Its biochemical characterization is still very incipient, being limited to specific classes of nutrients and secondary metabolites. Therefore, this study aimed at determining the total polyphenol content and key biological activity (antioxidant and anti-inflammatory properties) in the visceral mass and the head-foot part of this species from two different populations collected in Mira Estuary (Alentejo) and Praia da Luz (Algarve), mainland Portugal, and collected in two seasons, winter and summer.

Material/Methods/Design: Solitary specimens of *Vermetus triquetrus* were collected in the Mira Estuary (37°43'40"N, 8°46'13"W) in March and August, whereas gregarious specimens forming reef-like structures were collected at Praia da Luz (37°05'12"N, 8°43'52"W) in August. The antioxidant activity was measured by the (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid)) (ABTS) radical scavenging activity and the Ferric Ion Reducing Antioxidant Power (FRAP) method. The anti-inflammatory activity in the extracts from *R. okamurai* was analysed through an enzymatic methodology based on the inhibition of the cyclooxygenase-2 (COX-2).

Results & discussion: Polyphenol content presented variability between the two major anatomical parts, the head-foot and visceral mass, 142-334 vs 204-314 mg GAE/100 g dw, respectively. There was geographical and seasonal variability. Regarding the latter factor, while total phenolic content decreased in the visceral mass from winter to summer, 314±90 vs 204±34 mg GAE/100 g dw, the opposite was observed in the head-foot part, 142±14 vs 252±25 mg GAE/100 g dw. Concerning ABTS, displayed trends similar to those registered in the polyphenol levels, but with more pronounced variations. The lowest and highest ABTS activities were determined in the head-foot part, 1189±223 and 6064±3063 µmol Trolox Eq/100 g dw, in winter and summer, respectively. The ABTS activity of both body parts belonging to vermetids collected in Praia da Luz was intermediate. The antioxidant activity as measured by FRAP exhibited an even higher degree of variation, but ranging from 9.8±0.8 µmol Fe²⁺/g dw in head-foot winter Mira Estuary to 139.2±28.3 µmol Fe²⁺/g dw in head-foot summer Praia da Luz. Similarly, the head-foot part belonging to vermetids harvested from Praia da Luz in summer also had the highest anti-inflammatory activity, 41.4±28.0 % COX-2 inhibition. No anti-inflammatory activity was detected in samples from Mira Estuary during the summer.

Conclusion(s): The results show that not only is the vermetid *V. triquetrus* a source of bioactive compounds, but also that it matters its locality and harvest season.

P602 - Biodiversity Conservation, Nature Restoration, and Resource Valorisation Through Knowledge: The Portuguese Marine BioBank

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The GENEMARE_PORTUGAL project aims to establish a biobank for the Portuguese marine resources, being the conservation of biodiversity, nature restoration, and resource valorisation through a deeper knowledge major challenges. The GENEMARE biobank stands out as a strategic infrastructure in marine bioprospecting, demonstrating that international collaborations are fundamental for sharing biological resources and specialized knowledge, thus accelerating the isolation and development of innovative extracts with high potential for application in the biomedical and cosmetic industries. It encompasses a physical dimension (biological samples of organisms, cells, tissues) and a digital structure (genomic information, metabolomics data, meta-data) as well as research activities directed to less known organisms and less researched aspects of better known resources. This shall buttress the future valorisation of the biomass in the Atlantic Ocean. The presentation aim is to bring the activities and first outcomes of this project to the WEFTA community. The progress of the project will be presented and highlighted by two case-studies. The first encompasses the gastropod *Vermetus triquetrus*, which is a poorly known and underexplored marine resource. The second deals with the invasive seaweed *Rugulopteryx okamurae* in European waters. These case-studies involved a biochemical characterization of the organisms' biomass. IPMA is in the process of building a special site for preserving whole organisms, tissues, and cells — a marine Noah's ark. This required the setting up of deep-freezing and cryogenic systems, essential to preserve the biodiversity richness to future generations. All endangered and rare species will be kept viable, thereby ensuring its use for future actions of nature restoration. Another area where relevant advancement has been achieved concerns the installation and operation of cutting-edge technologies and advanced analytical methods for the biotechnological prospection of compounds and biological activities in marine biomass (such as *Vermetus triquetrus* or *Rugulopteryx okamurae*) with first published results pointing to a high potential for pharmaceutical and biotechnological applications. A digital platform customized to the project needs will be in place to manage biological material and data, while enabling the interaction with national and international entities and exchange of biological material and data. The future biobank shall also be a flagship structure contributing to raise awareness about the richness of our seas.

The GENEMARE biobank will pave the way to a deeper knowledge of marine life in the Atlantic, supporting biodiversity conservation and future nature restoration, developing innovative products for resource valorization, and connecting to other biobanks and research bodies nationally and internationally.

P701 - Intelligent Platform for Cold-Chain Management. Shelf-life Prediction by Modeling Microbial Growth of Chilled Stored Sea Bream Fillets

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Aim: Fresh fish fillets are highly perishable products, and temperature is the main factor controlling spoilage microbiota, sensory deterioration and shelf-life. Predictive models can describe microbial growth and estimate shelf-life for effective cold-chain management. This study aimed to model the growth kinetics of spoilage-associated microorganisms in sea bream fillets stored aerobically and estimate freshness status and shelf-life using primary and secondary models.

Material/methods/design: Sea bream (*Sparus aurata*) fillets stored in air and the microbial population changes were monitored at a range of storage temperatures. Microorganisms associated with spoilage development, including total viable counts, H₂S-producing bacteria, *Pseudomonas* spp., lactic acid bacteria and *Brochothrix thermosphacta*, were enumerated during storage and expressed as log CFU/g. Growth data were fitted with the Baranyi primary model to estimate maximum specific growth rate, lag phase and maximum population density. The temperature dependence of growth rates was further evaluated using square-root and Arrhenius-type secondary models.

Results and discussion: Storage temperature strongly affected spoilage microbial growth and sensory shelf-life. Aerobic shelf-life decreased markedly as temperature increased, confirming the need for temperature-dependent predictive tools. The Baranyi model described the growth of the main spoilage microbiota satisfactorily, allowing estimation of kinetic parameters for each microbial group and storage temperature. Maximum specific growth rates increased with temperature, particularly for the dominant aerobic spoilage microbiota, while lactic acid bacteria showed slower growth. Secondary modelling confirmed the strong temperature dependence of spoilage kinetics, with square-root and Arrhenius-type models enabling prediction of microbial growth rates across the tested temperature range. These models can therefore be used to estimate spoilage progression and remaining shelf-life under various storage temperature profiles.

Conclusions: Microbial growth models provides a practical framework for describing spoilage microbiota growth and estimating shelf-life of sea bream fillets. Such models by their incorporation into data-integration and decision-support platform can estimate shelf-life and contribute to cold-chain quality management optimization and reduction of fresh fish losses.

Acknowledgements: The project is funded by the General Secretariat for Research and Innovation of the Ministry of Development and Investments of Greece under the Project PRIMA 2023 "QuiPack" (Food value chain intelligence and integrative design for the development and implementation of innovative food packaging according to bioeconomic sustainability criteria). PRIMA Programme is an Art.185 initiative supported and co-funded under Horizon 2020, the European Union's Programme for Research and Innovation (PCI2024-153530 financed by MCIU/AEI/10.13039/501100011033 / UE)

P702 - Chitosan-based Antimicrobial Edible Coatings Affect Microbiota Profile and Extend Shelf-Life of Chill-Stored Sea Bream fillets

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Aim The aim of the present study was to investigate the effect of biodegradable chitosan-based packaging materials, on the microbiota profile and the spoilage microorganisms of sea bream fillets during refrigerated storage using both culture-dependent and culture-independent approaches.

Material/Methods Two types of chitosan were used for the preparation of edible coatings: commercial chitosan (co) and laboratory-produced chitosan (lab), each applied with or without the natural antimicrobial capsaicin. Coated sea bream fillets were stored at 4°C and monitored for microbiological changes using conventional culture-based methods, including Total Viable Counts (TVC), yeasts and molds, lactic acid bacteria (LAB), Enterobacteriaceae, *Pseudomonas* spp., and H₂S-producing bacteria. Microbial succession during storage was further characterized by 16S rRNA gene metabarcoding.

Results/Discussion Results indicated that fillets coated with laboratory-produced chitosan exhibited TVC values approximately 2 log CFU/g lower than those coated with commercial chitosan, regardless of capsaicin addition. Chitosan also effectively suppressed the growth of H₂S-producing bacteria and *Enterobacteriaceae*, reducing their populations to near or below the detection limit, while LAB populations remained around 3 log CFU/g after 5 days of storage. Although *Pseudomonas* spp. and yeasts/molds increased during storage, their populations were approximately 2 log CFU/g lower in samples treated with laboratory-produced chitosan than those treated with commercial chitosan throughout storage.

Metabarcoding analysis indicated the presence of several bacteria (e.g., *Corynebacterium*, *Flavobacterium*, *Pseudomonas*, *Propionibacterium*, etc.) at the beginning of storage. However, at advanced and especially at the end of storage, a high presence of *Pseudomonas* followed by *Psychrobacter* was observed in all treatments, even though their relative abundances were lower in samples treated with lab-scale chitosan with or without capsaicin. Notably, many differences were recorded between the studied treatments and the control, indicated that chitosan-based coating exhibited remarkable effect on the overall fish microbiota profile, while the lab-scale chitosan demonstrated better performance compared to commercial one.

Conclusions The findings of the present work indicated that chitosan coatings significantly reduced the population levels of spoilage bacteria. Chitosan-based coatings also altered the microbial succession of sea bream fillets, resulting in lower abundances of dominant spoilage taxa during refrigerated storage. These findings support the potential of chitosan as an effective biodegradable coating for improving the microbial quality of fresh fish fillets.

Acknowledgements The project is funded by the General Secretariat for Research and Innovation of the Ministry of Development and Investments of Greece under the Project PRIMA 2023 "QuiPack" an Art.185 initiative supported and co-funded under Horizon 2020.

P703 - Effect of Rosemary Water Extract and Chitosan on the Microbiological and Biochemical Stability of Gilthead Seabream (*Sparus aurata*) Fillets under MAP storage

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The high perishability of fresh fish represents a major challenge for the seafood industry due to rapid microbial proliferation and biochemical deterioration that compromise product quality and shelf life. In response to increasing demand for clean-label preservation strategies, plant-derived compounds such as rosemary (*Rosmarinus officinalis* L.) have gained attention due to their antioxidant and antimicrobial properties.

This study evaluated the effects of aqueous rosemary extract applied at different concentrations in combination with chitosan on the quality and shelf life of gilthead seabream (*Sparus aurata*) fillets during refrigerated storage. After treatment, samples were packaged under modified atmosphere packaging (MAP). Microbiological quality was monitored throughout storage, while biochemical changes were assessed using the TBARS assay and proteolysis index.

Microbiological results demonstrated a strong inhibitory effect of MAP and rosemary treatments on aerobic mesophilic bacteria. In untreated control samples, counts increased from approximately 10^3 CFU/g to around 10^7 CFU/g by the end of storage, indicating pronounced spoilage. MAP alone reduced final counts to approximately 10^4 CFU/g. All rosemary-chitosan treated samples further limited microbial growth, maintaining counts mainly within 10^2 – 10^3 CFU/g depending on treatment. No *Enterobacteriaceae*, *Salmonella* spp., *Listeria monocytogenes*, or sulfite-reducing *clostridia* were detected in any samples.

Biochemical analysis showed that lipid oxidation and proteolysis were significantly affected by treatments under MAP conditions. TBARS values were consistently lower in all treated groups compared with controls, with one treatment made of 1% (w/v) chitosan and 80% (v/v) rosemary showing the lowest lipid oxidation. Proteolysis was also reduced in treated fillets, with lower proteolysis index values compared with controls, particularly at the end of storage. The lowest final value was observed in treatment with 0.5% (w/v) chitosan and 80% (v/v) rosemary, indicating improved preservation of muscle proteins.

Overall, the combined application of rosemary extract, chitosan, and MAP effectively delayed microbial growth as well as oxidative and proteolytic spoilage in gilthead seabream fillets. These findings support the use of this hurdle technology as a sustainable and effective clean-label approach for extending the refrigerated shelf life of seafood products.

P704 - Gaseous versus aqueous ozone pretreatments for extending shelf life and preserving the quality of fresh sardines

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Aim of research: The aim of this study was to evaluate the effectiveness of gaseous and aqueous ozone treatments in preserving the quality and extending the shelf life of fresh sardines (*Sardina pilchardus*). Particular attention was given to identifying treatment conditions that maximize shelf-life extension while maintaining product quality.

Materials/methods/design: Fresh Adriatic sardines were treated with aqueous ozone (1 mg L⁻¹ for 5 min) or gaseous ozone (20 mg L⁻¹ for 5, 10, or 15 min). Untreated sardines served as controls. Samples were stored at 4 °C and analyzed every second day. Quality changes were assessed using the Quality Index Method (QIM), thiobarbituric acid reactive substances (TBARS), proteolytic index, and total volatile basic nitrogen (TVBN). Statistical differences were evaluated by one-way ANOVA followed by Tukey's HSD test ($p \leq 0.05$).

Results and discussion: All ozone-treated samples had a longer shelf life than the untreated control. QIM modelling indicated that theoretical shelf life increased from 8.37 days in control sardines to 9.74, 10.22, 9.99, and 8.80 days for aqueous ozone, gaseous ozone (5 min), gaseous ozone (10 min), and gaseous ozone (15 min) treatments, respectively. The greatest extension (+1.87 days) was achieved with gaseous ozone at 20 mg L⁻¹ for 5 min. Ozone treatment did not adversely affect the initial sensory quality of sardines. Gaseous ozone caused a moderate increase in initial TBARS values, especially at longer exposure times, indicating enhanced lipid oxidation. However, treated samples generally maintained lower TBARS values than the control during later storage stages. No consistent effect of ozone treatment on proteolytic activity was observed. Although TVBN values increased throughout storage in all samples, ozone-treated sardines generally exhibited slower quality deterioration than untreated fish.

Conclusions: Ozone treatment effectively extended the shelf life of refrigerated sardines without negatively affecting their sensory properties. Among the treatments tested, gaseous ozone at 20 mg L⁻¹ for 5 min provided the most favorable balance between quality preservation and shelf-life extension, demonstrating the potential of ozone as a sustainable, residue-free preservation technology for fresh fish products.

Funding: This paper has been funded by the European Union (NextGenerationEU) under the National Recovery and Resilience Plan 2021–2026 (NRRP), through the UNIZG FFTB institutional project “Innovative Application of Ozone for Shelf Life Extension and Safety Assurance of Foods of Animal Origin”, approved by the Ministry of Science, Education and Youth of the Republic of Croatia (component C3.2, source 581).

P705 - Influence of dietary thymol on the quality attributes of white shrimp (*Penaeus vannamei*)

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White shrimp (*Penaeus vannamei*) is highly valued by consumers due to its high nutritional value and unique sensory characteristics. However, the post-harvest supply chain faces serious challenges due to rapid product spoilage. The loss of quality is primarily due to the microbial growth, which leads to off-odours and texture softening, in addition to posing health risks. Furthermore, melanosis is a significant drawback in the commercialisation of white shrimp, as it drastically reduces consumer acceptance. Sulphites are commonly used to prevent melanosis, but they have other disadvantages, such as their association with allergic reactions and the fact that consumers are increasingly seeking additive-free products. For this reason, natural products, such as essential oils or their compounds, are being extensively studied to improve food quality while avoiding the use of additives. This study aimed to evaluate the effect of thymol (free or encapsulated in montmorillonite) supplemented in shrimp feed on the prevention of melanosis and the improvement of the microbial quality of white shrimp during cold storage. Four different feed formulations were prepared: a control diet (Control); the same diet supplemented with 150 mg/kg of thymol in free form (Thy150_Free), a diet supplemented with 150 mg/kg of thymol encapsulated in montmorillonite (Thy150_MM) and a diet supplemented with 1500 mg/kg of thymol encapsulated in montmorillonite (Thy1500_MM). The trial began with shrimp weighing approximately 1.8 g. Three aquariums per diet were used, each containing 25 specimens. The shrimp were hand-fed three times a day for 78 days. After this period, the shrimp were slaughtered and stored at 4 °C for 10 days. Microbial analyses and visual inspection to determine the degree of melanosis were carried out periodically. Mesophilic and psychrotrophic counts were slightly higher in the control samples than in shrimps fed thymol-supplemented feed. Regarding the effect on melanosis, shrimp fed control feed showed slightly higher melanosis scores on days 3 and 10 of storage, although the magnitude of these differences was small. These results demonstrate the potential of thymol encapsulated in montmorillonite as feed ingredients to slow microbial growth and melanosis. However, at the concentrations used in this study, the effect was insufficient to extend the shelf life of white shrimp. Higher concentrations and a longer study period would be needed to more clearly determine the efficacy of the compounds.

P706 - Enhancing Safety and Shelf Life of Cold-Smoked Salmon through Biological Preservation: The SLOPE Project

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Cold-smoked salmon, a popular ready-to-eat seafood product, is particularly vulnerable to contamination by *Listeria monocytogenes*, a pathogen that poses severe health risks to immunocompromised consumers. The project SLOPE (SaLmOn PhagE), funded by the German Federal Ministry of Research, Technology and SPACE (BMTFR), aims to enhance food safety and extend shelf life of cold-smoked salmon by using biological preservation methods, specifically protective cultures (lactic acid bacteria, LAB) and bacteriophages while conserving sensory quality.

The project started with in vitro evaluations of commercially available LAB strains, which are commonly used in the meat sector, with the aim of comparing the efficacy of bacteriocin-producing and non-bacteriocin-producing LAB strains in inhibiting *L. monocytogenes* growth. Results demonstrated that the selected LAB strains effectively suppressed *L. monocytogenes* proliferation under various processing conditions, including different smoking methods (traditional, liquid smoke, smoldering smoke), salting techniques (dry/wet/injection), and packaging types (vacuum/MAP). These findings confirmed the potential of LAB as biological preservation method for cold-smoked salmon, but the results also showed that complete elimination or a significant reduction of *L. monocytogenes* could not be achieved. Further microbiological hurdles are essential to realize a decrease of this important food borne pathogen.

The current work package builds on these results by combining LAB with *Listeria*-specific bacteriophages to achieve synergistic pathogen control. While in vitro and initial application trials show promising trends, comprehensive data regarding sensory impact, chemical stability, and the effects of long-term storage are currently being gathered. Preliminary observations suggest that this dual approach (LAB + phages) could enable more effective pathogen suppression than the use of LAB alone, without compromising product quality. This two-phase strategy ensures the step-by-step, evidence-based development of a practical preservation method for the fish industry, in close collaboration with the sector. By WEFTA 2026, we will present initial findings on this combined approach, as well as data from the trials involving the use of LAB alone.

P707 - Uncovering a Hybrid Epigenetic Defense Architecture in *Myxozoan* Parasites: Eukaryotic Guidance of a Horizontally Acquired Bacterial Weapon

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Aim of research: *Myxozoan* fish parasites exhibit targeted cytosine methylation (5mC) despite the evolutionary loss of canonical eukaryotic DNA methyltransferases (DNMTs). This study aimed to resolve this profound evolutionary paradox by determining whether a horizontally acquired bacterial Restriction-Modification (R-M) cassette acts as uncontrolled molecular noise, or if it has been functionally integrated into a precision-guided eukaryotic genomic defense system.

Material/methods/design: We performed high-resolution Oxford Nanopore (ONT) sequencing on two distinct developmental stages (actively dividing vegetative plasmodia with no spores and mature plasmodia with numerous spores) of a myxozoan parasite infecting the Amazonian teleost *Plagioscion squamosissimus*. To unmask the epigenetic landscape, we developed custom computational pipelines: density-aware residual profiling to measure motif clustering, deep-learning classification for single-molecule Horizontal Gene Transfer (HGT) breakpoint detection, frameshift-aware deep homology searches, and raw-signal cross-mapping to computationally uncouple structural DNA deletions from true epigenetic silencing across life stages.

Results and discussion: Our analysis shows that canonical eukaryotic gene-body methylation is functionally absent in this lineage. Instead, epigenetic targeting is exclusively restricted to dense structural anomalies: IS630 transposable elements, degraded retroviral "ghosts," and a newly discovered 40-bp heterochromatic mini-satellite array. By mapping 5mC modifications at single-base resolution, we identified a strict bimodal footprint peaking exactly at -5 bp and +8 bp around a conserved target motif. This provides biophysical proof of a steric "caliper" mechanism, where a eukaryotic SET-domain/transposase adapter complex physically binds to genomic threats, sterically constraining our primary suspect - the bacterial methyltransferase arms to selectively silence the array. Furthermore, cross-mapping raw electrical signals between developmental stages revealed an "epigenetic ghost" state: the parasite actively toggles this hybrid immune system "OFF" during sporogenesis, indicating dynamic eukaryotic control over the bacterial weapon.

Conclusion(s): This study refutes previous claims of mapping artifacts or random bacterial contamination in myxozoan epigenomics. We demonstrate an unprecedented evolutionary adaptation in aquatic parasites: the structural co-option of a bacterial R-M system via HGT, dynamically guided by eukaryotic adapter proteins to form a targeted, stage-specific heterochromatin lockdown system. This hybrid architecture represents a novel mechanism for maintaining genomic stability in highly reduced parasitic lineages.

Acknowledgement(s): Center of Research Excellence for Marine Bioprospecting – BioProCro, a project co-financed by the Croatian Government and the European Union through the European Regional Development Fund - the Competitiveness and Cohesion Operational Programme (PK.1.1.02): Sustainable bioprospecting of organisms from the Adriatic Sea for innovative natural products.

P708 - Bacterial communities linked to fish and fishing vessel gear: food safety considerations

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The study investigated cultivable bacterial communities from gill tissues of freshly harvested sardines and anchovies, and compared them with bacteria isolated from transport tank surfaces and fishing nets onboard a fish-seine vessel.

A total of 120 sardines and 120 anchovies were sampled (30/species/sampling point) using gill swabs. Additional samples were taken from fishing nets and fish storage tanks during use and after fish unloading onshore. Representative colonies were identified by MALDI-TOF MS, alongside physiological, morphological, and biochemical characterization.

In total, 471 isolates were obtained, representing 163 species across 74 genera. When grouped by origin (anchovy gills, sardine gills, tanks, and nets), sardine gills harbored the highest number of isolates. Tank surfaces yielded 56 isolates (26 species, 15 genera), nets yielded 41 isolates (23 species, 16 genera). Several species and genera were season-specific, with only a small fraction present in both seasons. *Pseudomonas vallis* was the only species detected on both fish species, as well as on tanks and nets, across all seasons.

Species shared between anchovy and tanks included *Exiguobacterium artemiae*, *Ex. mexicanum*, *Ex. oxidotolerans*, *Filifactor villosus*, *Psychrobacter* spp., *Ps. luti*, *Ps. maritimus*, and *Ps. namhaensis*. Species from anchovy and nets were *Microbacterium* spp., *Microbacterium luticocti*, *Photobacterium damsela*, *Psychrobacter* spp., *Ps. immobilis*, *Vibrio alginolyticus*, and *V. gigantis*. Sardine and tanks shared *Ex. mexicanum*, *F. villosus*, *Ochrobactrum intermedium*, *Ps. alimentarium*, *Ps. luti*, *Ps. maritimus* and *Ps. namhaensis*. Sardine and nets shared *Lactocaseibacillus paracasei*, *Lactobacillus reuteri*, *Microbacterium* spp., *Ps. veronii*, *Ps. alimentarius*, *V. alginolyticus* and *V. gigantis*.

These findings enhance understanding of microbial dynamics at the fisheries–environment interface and are relevant to environmental biotechnology, particularly for microbial risk assessment, food safety management, and the development of sustainable strategies to reduce spoilage and contamination in marine capture fisheries.

Acknowledgements

Center of Research Excellence for Marine Bioprospecting – BioProCro, a project co-financed by the Croatian Government and the European Union through the European Regional Development Fund - the Competitiveness and Cohesion Operational Programme (PK.1.1.02): Sustainable bioprospecting of organisms from the Adriatic Sea for innovative natural products.

P709 - Effect of Whole-Fish Marination on the Transfer of PCDD/Fs, PCBs and PFAS from Viscera to Muscle in Baltic Sprat (*Sprattus sprattus*)

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Introduction and aim. Utilisation of whole Baltic sprat (*Sprattus sprattus*) may increase raw-material yield, but retaining viscera during processing raises concerns about contaminant transfer to edible muscle. This study investigated the effects of fishing season and processing form on PCDD/Fs, dioxin-like and non-dioxin-like PCBs (dl-PCBs, ndl-PCBs), and PFAS in marinated sprat.

Materials and methods. Sprats caught in March and November were marinated for 7 days at 7°C in 3.5% acetic acid and 4.5% NaCl (fish:brine 1:1, w/w) as whole fish, gutted carcasses, or skin-on fillets. PCDD/Fs, dl-PCBs, ndl-PCBs, PFOS, PFOA, PFNA and PFHxS were determined in raw and marinated muscle and in viscera. Results were evaluated against maximum levels established in Commission Regulation (EU) 2023/915.

Results. PCDD/F + dl-PCB concentrations represented 16.4–51.4% of the maximum level (ML; 6.5 pg WHO-TEQ/g wet weight). Muscle concentrations were higher in spring than in autumn, whereas viscera showed the opposite seasonal pattern. ndl-PCB concentrations also remained below the ML of 75 ng/g wet weight, with higher muscle levels in spring and approximately 2.5-fold higher concentrations in autumn than spring viscera. Neither marination nor processing form significantly affected PCDD/F/dl-PCB or ndl-PCB concentrations in muscle. Whole-fish marination with viscera did not increase chlorinated POP concentrations relative to marinated fillets or gutted carcasses, indicating no substantial viscera-to-muscle transfer during the 7-day process. PFAS showed a different behaviour. The sum of PFOS, PFOA, PFNA and PFHxS represented 8.8–79.9% of the ML (8.0 µg/kg wet weight), with the highest concentration in spring viscera. PFOS predominated, accounting for 82.2–100% of the four regulated PFAS. In spring, total PFAS increased from raw muscle through marinated fillets and gutted carcasses to whole marinated fish, whereas no comparable pattern occurred in autumn. PFOA and PFHxS were detected in some marinated samples despite being below detection limits in the corresponding raw muscle.

Conclusions. Chlorinated POPs showed no evidence of transfer from viscera to muscle during marination, while PFAS displayed a season-dependent pattern consistent with possible redistribution during processing. All samples remained below applicable MLs, and fishing season had a greater influence on contaminant levels than processing form.

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Table of Contents

<u>WELCOME TO WEFTA 2026</u>	<u>2</u>
<u>COMMITTEES</u>	<u>3</u>
<u>WEFTA 2026 CONFERENCE PROGRAMME</u>	<u>4</u>
<u>POSTERS</u>	<u>9</u>
<u>KEYNOTES</u>	<u>11</u>
<u>ABSTRACTS</u>	<u>17</u>

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