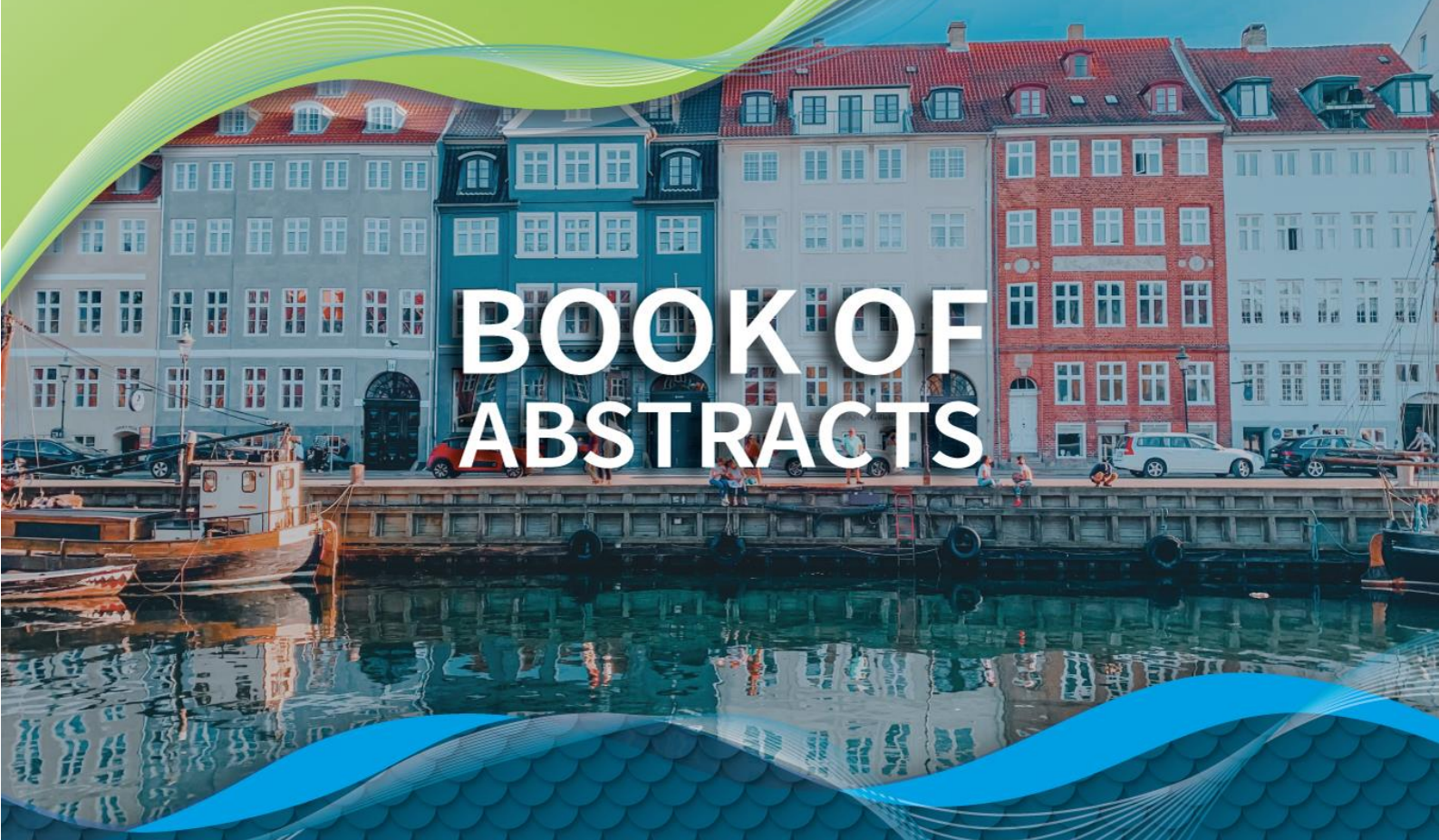
51th WEFTA CONFERENCE | Conference of Western European Fish Technologists Association



BOOK OF ABSTRACTS

51 WEFTA

Copenhagen, Denmark
16th - 20th October 2023.

CHANGING HOW YOU SEAFOOD

wefta2023.com

51st WEFTA CONFERENCE

The joint Conference of
Technical University of Denmark, Copenhagen, DK

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51 WEFTA

WELCOME ADDRESS

Welcome to the 51st WEFTA Conference

It is with great pleasure that we invite you to join the 51st Western European Fish Technologists Association (WEFTA) Conference, taking place in Copenhagen, Denmark from 16th - 20th October 2023.

In 1972, Denmark hosted the WEFTA first time, and since then three more WEFTA meetings have taken place in Denmark, and this year we are proud to welcome you back.

WEFTA is the central platform in Europe for institutions engaged in fish processing, applied food science, aquaculture, seafood technology, health effects of seafood consumption and consumer studies. WEFTA aims at improving safety and quality of seafood on and from the European and other markets through research within this area. Research activities of the WEFTA institutes are coordinated to the benefit of research institutes, the fishery industry, consumers, stakeholders and governments.

The annual WEFTA conference is a valuable occasion for scientists, students and the seafood industry to meet and present recent research achievements and to share experience. Besides, the conference constitutes an outstanding forum for discussions and networking.

The theme for this year's conference is: **Sustainable utilization of aquatic resources – changing the way we Seafood**. Through the following topics, we intend to broaden our knowledge and thus the way we Seafood. All aspects of fish technology, which lead to sustainable utilization of aquatic resources, can affect the way we Seafood.

The topics will be:

- ✓ Sustainable aquaculture and its link to seafood quality.
- ✓ Micro-/macroalgae and its applications in food.
- ✓ Side streams for food and non-food products to reach zero waste production.
- ✓ Processing and quality of seafood.
- ✓ Safety and authenticity.
- ✓ Consumer attitudes, societal challenges and seafood products.

Copenhagen, the host city of WEFTA 2023, is an unique city, characterized by its canals, cycling culture, stunning churches and museums, excellent Danish cuisine and happy locals. It is originally a Viking fishing village established in the 10th century, and Copenhagen became the capital of Denmark in the early 15th century. The Danish people like to be active, and more than 70% are members of different sports clubs and sports associations. This year conference will take place in DGI Byen (Danish Gymnastics and Sports Associations) Conference center, CPH Hotel, which is placed in the center of Copenhagen. Within walking distance, you will find numerous restaurants and bars, Tivoli, old and modern architecture, and some of the many canals.

Kind regards,

Nina Gringer
Chair WEFTA 2023

MEMBERS OF THE COMITTEES

MEMBERS OF THE ORGANISING COMMITTEE

- Nina Gringer (chair), DTU National Food Institute
- Flemming Jessen, DTU National Food Institute
- Lucas Sales Queiroz, DTU National Food Institute
- Sandra Stolzenbach Wæhrens, DTU National Food Institute
- Jonas Bang Asmussen, DTU National Food Institute

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- Heidi Nilsen, Nofima, Norway
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- Johan Robbens, ILVO, Belgium
- John Fagan, BIM, Ireland
- Margret Geirsdottir, Matis, Iceland
- Mercedes Careche, ICTAN, Spain
- Narcisa Bandarra, IPMA, Portugal
- Sanja Vidacek, University of Zagreb, Croatia
- Sari Makinen, LUKE, Finland
- Themis Altintzoglou, Nofima, Norway
- Ute Schroder, MRI, Germany

WEFTA AWARD SELECTION COMMITTEE 2023

- John Fagan (2022)
- Mercedes Careche (2019)
- Flemming Jessen (2018)
- Turid Rustad (2017)
- Francoise Leroi (2016)

Every year at the conference dinner, the WEFTA award is presented.

An annual award will be given to a WEFTA scientist who has contributed significantly and outstanding to the fields of seafood processing, seafood product development, seafood analytical methods, seafood safety, applied seafood science, seafood technology, seafood nutrition, aquaculture or consumer studies related to seafood.
The WEFTA award will be presented at the conference dinner on Wednesday 18th of October 2023 by the chairperson of the Award Committee.

WEFTA 2023 CONFERENCE PROGRAMME

Monday 16th October 2023

16:30-17:30	WEFTA working group, analytical method meeting in the conference hotel Johan Robbens, ILVO, Belgium
17:30-19:00	National Representatives meeting of WEFTA in the conference hotel Nina Gringer, Technical University of Denmark (DTU)
19:00-20:30	Welcome reception for participants of WEFTA 2023 and registration desk open in the conference hotel
20:30	Dinner national representatives WEFTA Location will be sent to the national representatives

Tuesday 17th October 2023

Chairperson	***Nina Gringer***
08:30-08:40	Opening Ceremony of WEFTA 2023
08:40-09:00 ***Keynote Speech***	**K01** John Fagan, Bord Iascaigh Mhara, Ireland (WEFTA award winner 2022) Research, Development and Innovation opportunities for the Irish seafood sector – we need your input
09:00-09:20 ***Keynote Speech***	**K02** Martin Bregnballe, Fangst, Denmark (Sea) food innovation from a non-scientific perspective

SESSION 1: Sustainable aquaculture and its link to seafood quality

Chairpersons	***Narcisa Bandarra*** ***Anna Thorsteinsdottir***
09:20-09:25	**OP01** Ragnhild Aven Svalheim, Nofima, Norway Evaluation of the multisensory system "Sensor Globe" as a fish welfare and quality indicator in wild capture fisheries
09:25-09:30	**OP02** Sophie Kendler, NTNU, Norway Farmed vs. wild European plaice (*Pleuronectes Platessa*) - Nutritional, chemical, and physiochemical quality
09:30-09:35	**OP03** Patrícia Sofia Laranjeira Anacleto, IPMA, Portugal How mycotoxins in aquafeeds affect animal condition and nutritional quality: gilthead seabream *Sparus aurata* as case study
09:35-09:55	**OP04** Flávia Vasconcelos de Mello, University of Lisbon, Portugal Ecotoxicological responses of juvenile gilthead seabream (*Sparus aurata*) exposed to mycotoxins.

09:55-10:15 **OP05** Vera Liane Ferreira Barbosa, IPMA / FCT NOVA, Portugal
Eco-Innovative biofortified farmed gilthead seabream (*Sparus aurata*) and common carp (*Cyprinus carpio*): effects of processing on nutritional value

10:15-10:20 **OP06** Natacha Leininger Severin, University of Copenhagen, Denmark
Biological variation of Greenland halibut (*Reinhardtius hippoglossoides*) - Optimization of sustainability, quality and commercial value (*Qaleralik*)

10:20-10:25 **OP07** Marco Frederiksen, Eurofish International Organisation, Denmark
Eurofish International Organisation - for the development of fisheries and aquaculture in Europe. Research and development activities

10:25-11:00 Coffee Break

CONTINUATION SESSION 1: Sustainable aquaculture and its link to seafood quality

Chairpersons ***Ragnhild Aven Svalheim***
Natacha Leininger Severin

11:00-11:20 **OP08** Aberham Hailu Feyissa, Technical University of Denmark, Danmark
Sustainable fish production through insect-powered feed processing: modeling and optimization of resource, process and quality parameters

11:20-11:25 **OP09** Anna Thorsteinsdottir, Technical University of Denmark, Denmark
The effects of ingredient formulation with insect meal on the rheological properties of fish feed melt

11:25-11:45 **OP10** Sæmundur Elíasson, Matís, Iceland
Utilization of water and blood to improve sustainability of land-based salmon aquaculture

11:45-12:05 **OP11** Narcisa Bandarra, IPMA, Portugal
Chub mackerel and quinoa improve liver DHA status in Alzheimer disease: an opportunity for the upgrading of undervalued fish species

12:05-12:25 **OP12** Hatairad Phetsang, Chalmers University of Technology, Sweden
New strategies for mitigating undesirable odors of geosmin and 2-MIB in freshwater fish products

12:25-12:30 **OP13** Ana G Cabado, ANFACO.CECOPESCA, Spain
Assessment of the nutritional quality indexes of lipids in meagre fish, sea bream and octopus

12:30-12:35 **OP14** Dat Trong Vu, NTNU, Norway
Simulated digestion of red sea cucumber (*Parastichopus tremulus*) - protein quality and antioxidative capacity

12:35-12:40 **OP15** Gizem Nazlı Ural, Akdeniz University, Turkey
Alginate and cuttlefish ink-based caviar-like hydrogel beads as alternative to sturgeon caviar: Comparison of physicochemical properties

12:40-13:55 **Lunch Break**

SESSION 2: Micro-/macroalgae and its applications in food

Chairpersons ***Izumi Sone***
Cláudia Afonso

13:55-14:15 **OP16** Susan L. Holdt, Technical University of Denmark, Denmark
Seaweed market barriers in the food legislation- a need for a more balanced view on seaweed benefits and risks

14:15-14:20 **OP17** Ove Johansen, Nofima, Norway
Opportunities and barriers to the application of macroalgae in food

14:20-14:25 **OP18** Narcisa Bandarra, IPMA, I.P., Portugal
Effect of dehydration, rehydration and thermal treatment on the bioactive, nutritional and sensory profiles of red seaweed *Porphyra umbilicalis*

14:25-14:45 **OP19** Randi Sund, Nofima, Norway
The effect of freezing and thawing on *Alaria esculenta*

14:45-15:05 **OP20** Anna Þóra Hrólfsdóttir, University of Iceland, Iceland
Physicochemical- and bioactive properties of acid preserved *Alaria esculenta* and *Saccharina latissima* during storage

15:05-15:25 **OP21** Inga Marie Aasen, SINTEF, Norway
Effective preservation of seaweed and the impact on properties of importance for use as food ingredient

15:25-15:30 **OP22** Caroline Østergaard Klein, Technical University of Denmark, Denmark
Salt pickling as a post-harvest treatment to prolong shelf-life of sugar kelp (*Saccharina latissima*)

15:30-16:00 **Coffee Break**

CONTINUATION SESSION 2: Micro-/macroalgae and its applications in food

Chairpersons ***Anna Þóra Hrólfsdóttir***
Caroline Østergaard Klein

16:00-16:20 **OP23** Pernille Kristiane Skavang, SINTEF Ocean, Norway
Fermentation of seaweed for seafood products and evaluation of product quality, shelf-life, and bioactivities

16:20-16:25 **OP24** Margrét Geirsdóttir, Matís, Iceland
Sensorial properties of *Arthrospira platensis* and it´s extracts enhanced by different heat treatments or enzymatic hydrolysis

16:25-16:30 **OP25** Izumi Sone, Nofima, Norway
Formation and characterization of sodium alginate/sodium caseinate nanoparticles for curcumin

16:30-16:35 **OP26** Johan Robbens, ILVO, Belgium
Usage of microalgae as seafood flavoring agent

16:35-16:55 **OP27** Carlos Cardoso, IPMA, Portugal
Do benefits outweigh risks in seaweed as food? Case-study assessment with integration of bioaccessibility information

16:55-17:00 **OP28** Cláudia Afonso, IPMA, Portugal
Seaweed and chub Mackerel Hamburger: a functional food for preventing cognitive decline by enhancing bioaccessible fatty acids, selenium and iodine

17:00-17:05 **OP29** Reut Sahvit, Algiecel, Denmark
Algiecel, biosolutions for decarbonization

Wednesday 18th October 2023

SESSION 3: Side streams for food and non-food products to reach zero waste production

Chairpersons ***Federico Casanova***
Erasmo Cadena

08:30-08:50 **OP30** Ann-Dorit Moltke Sørensen, Technical University of Denmark, Denmark
Production of savoury ingredient, an upcycling route for cod backbone

08:50-08:55 **OP31** Helena M. Moreno Conde, University Complutense of Madrid, Spain
Valorization of Spanish rainbow trout (*Oncorhynchus mykiss*) muscle to obtain restructured products

08:55-09:15 **OP32** Mehdi Abdollahi, Chalmers University of Technology, Sweden
Personalizing the texture of seafood products via food 3D printing technology

09:15-09:20 **OP33** Adrián Honrado Frías, Universidad de Zaragoza-CITA, Spain
Bioactive compounds from fish by-product: a feasibility study for the development of innovative foods

09:20-09:40 **OP34** Grethe Hyldig, Technical University of Denmark, Denmark
Does the consumer have any barriers and/or motives for new ingredients produced from seafood side-streams?

09:40-10:00 **OP35** Rasa Slizyte, SINTEF Ocean, Norway
Can high quality gelatine be obtained from preserved whitefish skins?

10:00-10:20 **OP36** Cécile Dargentolle, Matís, Iceland
Extraction of gelatine and other compounds of interest from lumpfish

10:20-10:25 **OP37** Abhilash Sasidharan, NTNU, Norway
Utilization of Atlantic lumpfish (*Cyclopterus lumpus*) skin as a source for gelatine extraction

10:25-10:30 **OP38** Revilija Mozuraityte, SINTEF Ocean, Norway
Lipid oxidation during ensilaging of salmon by-products and effect of pH and antioxidants

10:30-11:00 Coffee Break

CONT.SESSION 3: Side streams for food and non-food products to reach zero waste production

Chairpersons ***Revilija Mozuraityte***
Cécile Dargentolle

11:00-11:20 **OP39** Erasmo Cadena, Ghent University, Belgium
Valorization of solid seafood side-streams. Life cycle assessment of an enzymatic hydrolysis technology to recover flavoring agents from salmon backbones

11:20-11:40 **OP40** Elissavet Kotsoni, NTNU, Norway
Influence of high-pressure processing in the chemical composition and yield of fractions from a mixture of rainbow trout (*Oncorhynchus mykiss*) and Atlantic salmon (*Salmo salar*) rest raw material after enzymatic hydrolysis

11:40-12:00 **OP41** Jaakko Hiidenhovi, Natural Resources Institute Finland (Luke), Finland
Baltic herring hydrolysates: their effects on an in vivo mouse model of obesity

12:00-12:05 **OP42** Ana Fuentes, Universitat Politècnica de València, Spain
Antidiabetic properties of mackerel by-product hydrolysates

12:05-12:25 **OP43** Kyriaki Tsirtsidou, Ghent University / ILVO, Belgium
Pectin/marine-chitosan hydrogel with improved properties for the delivery of phenolic compounds from strawberries

12:25-12:30 **OP44** Lucas Sales Queiroz, Technical University of Denmark, Denmark
Synergic interaction between chitosan and peptides from shrimp side-streams (*Pandalus borealis*) before and after pulsed electric field treatment, a study focused on emulsifying property

12:30-12:35 **OP45** Federico Casanova, Technical University of Denmark, Danmark
Interfacial and emulsifying properties of enzymatically derived peptides from shrimp head and shell

12:35-12:55 **OP46** Ingrid Undeland, Chalmers University of Technology, Sweden
The seafood process water biorefinery -from waste to value

12:55-13:00 **OP47** Hildur Inga Sveinsdóttir, Matís, Iceland
Utilization of side streams from processing water in whitefish production

13:00-14:00 Lunch Break

CONT.SESSION 3: Side streams for food and non-food products to reach zero waste production

Chairpersons ***Lucas Sales Queiroz***
Hildur Inga Sveinsdóttir

14:00-14:05 **OP48** Monica Gutierrez, AZTI, Spain
Production of savory compounds from mussel cooking water side stream

14:05-14:25 **OP49** Carlos Bald, AZTI, Spain
Production of savoury compounds from salmon processing side-streams

14:25-14:30 **OP50** Bruno Iñarra, AZTI, Spain
Production of bioactive compounds from fish discards

14:30-14:50 **OP51** Birthe Vang, Nofima, Norway
Food for kings, use of lumpfish as feed for red king crab

SESSION 4: Consumer attitudes, societal challenges and seafood products

Chairperson ***Themistoklis Altintzoglou***
Margrét Geirsdóttir

14:50-14:55 **OP52** Cheryl Marie Cordeiro, RISE Research Institutes of Sweden, Sweden
Resilient future food systems: extending consumer knowledge along the fish value chain

14:55-15:00 **OP53** Morten Heide, Nofima, Norway
More sustainable salmon

15:00-15:05 **OP54** Olga Szulecka, National Marine Fisheries Research Institute, Poland
Consumers' perceptions of low-value cyprinid fish and products from them

15:05-15:10 **OP55** Jørgen Lerfall, NTNU, Norway
IntER-Cold: interdisciplinary education and research platform in cold-chain of fish: From Norway to Japan

15:10-15:35 Coffee Break

SESSION 5: Safety and authenticity

Chairpersons ***Torbjørn Tobiassen***
Marina Usieto

15:35-15:55 **OP56** Ute Schröder, Max Rubner-Institut, Germany
New methods and concepts to identify mislabeled seafood

15:55-16:15 **OP57** Alexandre Dehaut, Anses, France
Microplastics in seafood: study of different fish transformation process in the frame of contamination mitigation

16:15-16:35 **OP58** Julia Süssmann, Max Rubner-Institut (MRI), Federal Research Institute of Nutrition and Food, Germany

Microplastic quantification with mass-based methods in seafood products – exploring the potential for fast and reliable analysis

16:35-16:55 **OP59** Andrea Rakel Sigurðardóttir, University of Iceland, Iceland
Exploring multispectral imaging for nematode identification in fish fillets: towards automated detection

16:55-17:00 **OP60** Ziwei Lu, University of Iceland, Iceland
The influence of physical and geometrical changes on the insulation and strength of expanded polystyrene food packaging

19:00-00:00 Galla Dinner at the conference hotel

Thursday 19th October 2023

CONTINUATION SESSION 5: Safety and authenticity

Chairpersons ***Alexandre DEHAUT***
Ziwei Lu

9:15-9:20 **OP61** Marina Usieto, ICTAN-CSIC, Spain
High throughput screening method for *ANISAKIS* L3 detection of locomotor activity and viability under thermal-induced stress

9:20-9:40 **OP62** Dionysios Tsoukalas, NTNU, Norway
Genotypic and phenotypic characterization and spoilage potential of Photobacterium strains isolated from European plaice (*Pleuronectes platessa*)

SESSION 6: Processing and quality of seafood

Chairpersons ***James Whalin***
Karsten Heia

9:40-10:00 **OP63** Margrethe Esaiassen, Nofima, Norway
Live storage of European plaice - welfare and quality

10:00-10:05 **OP64** Torbjørn Tobiassen, Nofima, Norway
Large cod more susceptible to injuries in seine fishing

10:05-10:25 **OP65** Arne Schröder, Thünen Institute of Sea Fisheries, Germany
Technological, economic, and social aspects of an innovative shrimp de-shelling technique

10:25-10:30 **OP66** Signe Vangsgaard, Royal Greenland, Denmark
Gentle peeling of cold-water prawns (*Pandalus borealis*)

10:30-11:00 Coffee Break

CONTINUATION SESSION 6: Processing and quality of seafood

Chaipersons ***Janna Cropotova***
Arne Schröder

11:00-11:20 ***Keynote Speech***	**K03** Sofie Theresa Thomsen, Technical University of Denmark, Denmark Human health risk-benefit assessment - a tool to evaluate the tradeoffs between chemical and microbiological risks and nutritional benefits of fish and seafood consumption
11:20-11:25	**OP67** Gorana Drobac, Nofima AS, Norway The effect of subchilling and storage conditions of brown trout (*Salmo trutta*) on shelf life
11:25-11:30	**OP68** Kristin Beate Hansen, Nofima AS, Norway Weight gain of Atlantic cod (*Gadus morhua L.*) during storage in refrigerated seawater (RSW) and drip loss during further storage on ice
11:30-11:35	**OP69** Anita N Jakobsen, NTNU, Norway Application of a portable multispectral imaging prototype for detection of spoilage in Atlantic salmon (*Salmo salar L.*) stored on ice
11:35-11:40	**OP70** Karsten Heia, Nofima, Norway Industrial solution based on hyperspectral imaging for the determination of remaining shelf life in Atlantic cod
11:40-11:45	**OP71** Jørgen Lerfall, NTNU, Norway A machine learning approach for the estimation of freshness in Mediterranean seabream using a portable Multispectral Imaging (MSI) device
11:45-12:05	**OP72** Yusa Nakamura, Tokyo University of Marine Science and Technology, Japan Aging promotion of greater amberjack (*Seriola dumerili*) meat by using liquid Shio-koji
12:05-12:10	**P73** Rowan Romeyn, Nofima, Norway Hyperspectral imaging to detect blood and melanin defects in salmon fillets
12:10-12:15	**OP74** Samuel Ortega, Nofima, Norway Texture characterization of Atlantic salmon using non-invasive imaging technologies
12:15-12:20	**OP75** Adane Tilahun Getachew, Technical University of Denmark, Denmark Optimization of extraction of round goby (*Neogobius melanostomus*) oil using supercritical carbon dioxide
12:20-12:40	**OP76** James Whalin, Chalmers University of Technology, Sweden Show me the hemoglobin! A route to better understand the rapid lipid oxidation in Herring (*Clupea harengus*)
12:40-13:00	**OP77** John Axelsson, Chalmers University of Technology, Sweden Distribution of persistent organic pollutants (POPs) in Baltic herring (*Clupea harengus membras*) and scalable routes to its removal
13:00-14:00	**Lunch Break**

CONTINUATION SESSION 6: Processing and quality of seafood

Chairpersons ***Anita N Jakobsen***
John Axelsson

14:00-14:20 **OP78** Janna Cropotova, NTNU, Norway
Effect of ultrasound treatment on functional and quality parameters of fish protein hydrolysate (FPH) extracted from Atlantic mackerel (*Scomber scombrus*)

14:20-14:25 **OP79** Kristine Kvangarsnes, NTNU, Norway
Effect of ultrasound pre-treatment prior to enzymatic hydrolysis on functional and quality parameters on fish protein hydrolysate extracted from herring (*Clupea harengus L*)

14:25-14:45 **OP80** Maria Alquiza Madina, SINTEF OCEAN, Norway
Enzymatic activity in mesopelagic species: enhancing the quality and sustainability of the raw material

14:45-14:50 **OP81** Andreas Langdal, UiT The Arctic University of Norway, Norway
The environmental footprint and utilization potential of novel marine resources

14:50-14:55 **OP82** Jayalal Kalathilparambil Jayanthan, The Norwegian College of Fishery Science, Norway
SECURE: harnessing low-trophic level marine organisms for sustainable food and health benefits

14:55-15:00 **OP83** Yuri Kominami, The University of Tokyo, Japan
Mass transfer during dehydration of flounder fillet with dried kelp

15:00-15:20 **OP84** Jose Antonio Beltran, University of Zaragoza, Spain
Sea to pasta: an innovative food

15:20-15:25 **OP85** Juan B. Calanche M., University of Zaragoza, Spain
Relationship between consumer`s preference and food quality parameters for eco-friendly Seabass (*Dicentrarchus labrax*)

CLOSING CEREMONY

15:25-15:35 Report WEFTA national representative meeting and WEFTA analytical workgroup
Nina Gringer DTU, Denmark & Johan Robbens, ILVO, Belgium

15:35-15:45 WEFTA 2024 announcement! (?)

15:45-16:55 **Closing WEFTA 2023**
Nina Gringer DTU, Denmark

Friday 20th October 2023

9:00-19:00 Social day

Posters

SESSION 1: Sustainable aquaculture and its link to seafood quality

P01 Narcisa Bandarra, IPMA, Portugal
Nutritional upgrading of a little-studied marine resource: *Physalia physalis*

P02 Giuliana Parisi, University of Florence, Italy
Thinking different strategies for indexing fatty acids in fish fillets Part I: rainbow trout as a case-study

P03 Giuliana Parisi, University of Florence, Italy
Thinking different strategies for indexing fatty acids in fish fillets Part II: gilthead seabream as case-study

SESSION 2: Micro-/macroalgae and its applications in food

P04 Susan L. Holdt, Technical University of Denmark, Denmark
Blanching of two commercial Norwegian brown seaweeds - for reduction of iodine and other compounds of importance for food safety and quality

P05 Carlos Cardoso, IPMA, Portugal
Assessment of the biotechnological potential of three invasive seaweed species in the Portuguese coast

SESSION 3: Side streams for food and non-food products to reach zero waste production

P06 Bruno Iñarra, AZTI, Spain
Exploring the potential of the twilight zone: on the use of *Maurolicus muelleri*

P07 Carlos Cardoso, IPMA, Portugal
The biological activity of the biomass of three invasive ascidians in NE Atlantic: an innovative functional food as a possible applications

P08 Janna Cropotova, NTNU, Norway
Heterotrophic growth of microalgae *Galdieria sulphuraria* on residues from aquaculture and fish processing industries

P09 Ann-Dorit Moltke Sørensen, Technical University of Denmark, Denmark
Recovery of protein and phosphorus from cod processing waters using flocculation

P10 Martina Bergentall, RISE Research Institute of Sweden, Sweden
Solid-phase fermentation of side streams from sugar kelp production

P11 Mehdi Abdollahi, Chalmers University of Technology, Sweden
Resource-smart valorization of fish processing side streams via ultrasound-aided pH-shift processing

P12 Jørgen Lerfall, NTNU, Norway
Marine fishery discards as raw pet food for a sustainable Europe - Innovative curriculum development

SESSION 4: Consumer attitudes, societal challenges, and seafood products

P13 Carlos Bald, AZTI, Spain
Consumer awareness and perceptions of the use of fish processing by-products in bio-fertilisers production

P14 Pernille Kristiane Skavang, SINTEF Ocean AS, Norway
Conceptualization and quantification of the Norwegian feed system

P15 Ana Fuentes, Universitat Politecnica de Valencia, Spain
How environmental factors influence the fish products purchase decision

P16 Florent Govaerts, Nofima, Norway
Explaining consumers' behaviour towards fish welfare: The role of empathy in extending the value-belief-norm model

P17 Isabel Fernández Segovia, Universitat Politecnica de Valencia, Spain
Knowledge and perception of teenagers regarding fish products

P18 Ragnhild Aven Svalheim, Nofima, Norway
The catch welfare platform: a multidisciplinary approach for improving fish welfare in global fisheries

P19 Themistoklis Altintzoglou, Nofima, Norway
Consumer segments and their responses to fish welfare issues

SESSION 6: Processing and quality of seafood

P20 Ditte B. Hermund, Technical University of Denmark, Denmark
Development of an infusion method to enhance moisture retention in cod loins: Testing a combination of 2.6% (w/w) NaCl and protein hydrolysates

P21 Ingrid Undeland, Chalmers University of Technology, Sweden
Antioxidative role of lingonberry press cake during pH-shift processing of sensitive fish rest raw materials

P22 Isabel Fernández Segovia, Universitat Politecnica de Valencia, Spain
Development of fish pâté with fish bone powder and seaweeds

P23 M. Carmen Gómez-Guillén, ICTAN-CSIC, Spain
Surimi gels formulated with antioxidant coconut oil emulsions stabilised by chitosan nanoparticles

P24 Elvira López, ICTAN-CSIC, Spain
Effect of simulated gastrointestinal digestion on bioactive properties of *Holoturia foskalii* hydrolysates encapsulated in two nanostructure systems

P25 M. Pilar Montero, ICTAN-CSIC, Spain
Potential mucoadhesive capacity of chitosan nanoparticles and rapeseed lecithin liposomes

P26 Timothé OUDIN, ULCO-BPA, France
Mitochondria as targets for quantifying seafood quality by measuring the production of reactive oxygen species

P27 Izumi Sone, Nofima, Norway
Formation and characterization of sodium alginate/sodium caseinate nanoparticles for curcumin

P28 Patrícia Anacleto, IPMA, Portugal
Incidence, bioavailability, and mitigation strategies for mycotoxins in farmed fish and feeds: Gilthead seabream as case study

P29 Abhilash Sasidharan, NTNU, Norway
Utilization of Atlantic lumpfish (*Cyclopterus lumpus*) skin as a source for gelatine extraction

P30 Revilija Mozuraityte, SINTEF Ocean, Norway
Lipid oxidation during ensilaging of salmon by-products and effect of pH and antioxidants

P31 Ziwei Lu, University of Iceland, Iceland
The influence of physical and geometrical changes on the insulation and strength of expanded polystyrene food packaging

P32 Lorenzo Chinellato, DTU, Denmark
Fermentation of Green Crab (*Carcinus Maenas*) for human consumption

KEYNOTES

SESSION 1	Research, development, and Innovation opportunities for the Irish seafood sector – we need your input

K01

NAME: John Fagan (WEFTA- award winner of 2022)

Institute/Organization: Bord Iascaigh Mhara (BIM)

Topic

The Irish Seafood sector was valued at €1.3billion in 2022 with 160 Irish seafood processing facilities, 1993 registered fishing vessels and 319 aquaculture companies operating throughout the country. As experienced within all global seafood supply chains, numerous factors are directly affecting performance of the sector including significant pressure to ensure supply chains are sustainable and transparent, the need to de-carbonise traditionally energy intensive processes, the push to automate driven by increasing labour costs and changing market dynamics brought about by new and disruptive technologies developed by global competitors. More than ever, we need the global seafood R&D community to align knowledge and approach to explore new technologies around optimizing raw material quality and shelf-life, monitoring and reducing the environmental impact of fishing, processing and aquaculture supply chains and creating new and circular approaches to maximization of all biomass (fisheries/processing/aquaculture) to ensure we are exploiting these in the most sustainable way possible. This keynote address will discuss various factors affecting the Irish seafood sector and discuss examples of fisheries, processing and aquaculture initiatives Ireland Inc is exploring to both valorize and safeguard the Irish seafood sector. BIM is heavily involved in identifying global knowledge and solutions, testing these with the Irish seafood sector and exploring whether these can be scaled to add further value, improve sustainability credentials, and increase margins or decrease costs. The knowledge generated by WEFTA scientists over the past 20+ years continues to inform best practice across the seafood supply chain and is actively aligning a global approach to ensuring our valuable aquatic resources are used in the most sustainable way possible.

Curriculum

John Fagan is a Senior Food Technologist at Bord Iascaigh Mhara (BIM) and works with the Irish seafood processing sector to identify new opportunities to drive sustainable growth. He is the WEFTA National Representative for Ireland and has been attending WEFTA for 20+ years. Most of his work consists of working closely with Irish whitefish, pelagic, shellfish processors and fishers to maximize quality and value throughout the supply chain. John is part of a team driving business development and Innovation with key clients who are investing heavily in new technologies aimed at process automation, quality optimsation, new product development and digitization. BIM works across all parts of the Irish seafood sector including processing, aquaculture, fisheries and more recently, BIM monitors and actively engages with global RDI individuals and networks to stay abreast of commercially-attractive processing and AQUA-TECH opportunities. A large volume of BIM's work involves identifying global innovations, expertise and new solutions, trialing, and testing these under Irish commercial conditions and providing funding and training to develop new business opportunities. While John started life in the laboratory exploring the influence of packaging, processing and clean-label ingredients on shelf-life of whitefish, salmonid and pelagic fish species, more recently he is part of a Demersal team scanning globally for new opportunities to add further value to the Irish seafood sector. WEFTA is a hugely valuable platform for researchers to share their knowledge and expertise with a global network of experts and BIM works closely with various WEFTA RDI groups to access test centers, equipment and explore new concepts together. John will discuss key needs and opportunities for the Irish seafood sector and opportunities for WEFTA experts to address some of the ongoing issues along the seafood supply chain. Issues such as new sustainable technologies for increasing shelf-life, decreasing costs, enhancing competitiveness and future-proofing seafood supply chains will be discussed. By the end of 2023, Irish seafood processors will have invested up to €45million in upgrading processing factories, buying new equipment, and automating previously manual processes. John is keenly interested in understanding R&D with high technology readiness levels (TRL) which can be trialled, scaled, and implemented in client companies within short time spans and is very excited to learn more about your R&D.

SESSION 2	(Sea) food innovation from a non-scientific perspective.

K02

NAME: Matin Bregnballe

Institute/Organization: FANGST - canned seafood from Nordic waters

Topic

If one of our new product launches wins an innovation prize, it's a sure sign that it will fail in the market…!'

Those were the words from an experienced marketing manager in the first company Martin worked in. A sentence that has stuck with him ever since, but also sparked his interest: What drives innovation in food - and what makes it succeed or fail?
Based on his first-hand experience, from the smallest food companies to the largest corporations, from startups to established businesses, from successes to failures, and from land to water - Martin will share his observations and perspectives on food innovation in practice. Prepare for a no-nonsense, non-scientific and non-research based, but personal presentation.

Curriculum

Martin Bregnballe grew up in a family of biologists, scientists and fish farmers. However, Martin took more interest in how to make good food out of nature's resources, create innovative food concepts and develop strong brands.
He has worked in many areas of food and business development, beginning his career with brand management, product development and process optimization at Nestlé Nordic.
After Nestlé, Martin took an MBA at London Business School, then returned to Denmark where he established a business in organic convenience food and gained his first experience with food startups.
The innovative food entrepreneur Claus Meyer, who is recognized as one of the main innovators behind the 'new Nordic cooking wave', and his group of food businesses became the next stop and source of inspiration for Martin, where he worked as Development Director.
Having accumulated a diverse knowledge of marketing and innovation in food, Martin then decided to share his insights as a business development consultant for food companies for a number of years. Also, he co-founded Copenhagen Food Space, an incubator and office space for food entrepreneurs.
Now Martin has started a new company, FANGST - canned seafood from Nordic waters. With a traditional technology, but a different take on consumers, marketing and product development, he is now showing a way to turn 'low value' species into gourmet foods.

SESSION 3	Human health risk-benefit assessment - a tool to evaluate the tradeoffs between chemical and microbiological risks and nutritional benefits of fish and seafood consumption

K02

NAME: Sofie Theresa Thomsen

Institute/Organization: National Food Institute, DTU

Topic

Fish and other seafood are important sources of nutrients that are beneficial for human health. However, fish and other seafood are also sources of chemical contaminants and pathogens that pose a risk to human health. Due to the diversity in the associated health outcomes of nutrients, chemicals, and pathogens, the evaluation of the tradeoffs between chemical and microbiological risks and nutritional benefits associated with fish consumption is complex. Quantitative human health risk-benefit assessment offers a framework to quantify and weigh health risks and benefits associated with food consumption to provide scientific evidence to inform public health policies, food safety regulations, and recommendations in food safety and nutrition. Fish and other seafood are by far the most intensively studied food group in risk-benefit assessments. This presentation will introduce the concepts of human health risk-benefit assessment and give examples of such assessments of fish and other seafood, including findings, limitations, and methodological needs. Finally, the opportunities for applying the risk-benefit assessment framework in a broader perspective also accounting for other impacts of fish and seafood consumption, such as different aspects of sustainability, will be discussed.

Curriculum

Sofie Theresa Thomsen holds a PhD in Life Science and is a researcher at the National Food Institute, Technical University of Denmark. Part of her research focuses on quantitative health impact assessment of foods. This includes quantitative risk-benefit assessments accounting for both the impact of chemical hazards and nutrients in foods on public health. Much of her research has been surrounding fish and seafood, including a comprehensive quantitative assessment of the balance between chemical risks and nutritional risks and benefits of various seafood consumption scenarios in the Danish population. Furthermore, Sofie is involved in the Danish initiative to estimate the burden of disease of food-associated chemicals, aiming to estimate and rank the impact of chemical contaminants in food on public health such as those present in fish and seafood including methyl mercury, dioxin and dioxin-like polychlorinated biphenyls (PCBs), and per- and polyfluoroalkyl substances (PFAS).

Abstracts

SESSION 1	Evaluation of the multisensory system "Sensor Globe" as a fish welfare and quality indicator in wild capture fisheries

OP1

Name: Ragnhild Aven Svalheim **Organization:** Nofima

Authors: Ragnhild Aven Svalheim* [1], Kristin Hansen[1], Gustav Martinsen[1] and Mia Moseng[2]

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Abstract

This study examines the benefits, difficulties, and future potential of employing the Sensor Globe multisensory system as an indicator of welfare in wild capture fisheries. We investigated the applicability of the Sensor Globe multisensory system in monitoring fish welfare and identifying operations that may have negative effects on quality. Originally designed for aquaculture, the Sensor Globe technology enables non-invasive assessment of various abiotic factors that significantly impact animal welfare and product quality, such as oxygen levels, pH, temperature, and force. The sensors were attached to the net and immersed with the fishing gear. Once the net approached the vessel, the sensor was released and pumped onboard alongside the fish. This allowed the sensor to remain with the fish throughout the entire capture and handling process. We found that the sensors performed well when used with demersal seine nets at depths of down to 200 meters. However, we experienced leakage in the charging port on one sensor. Despite this, the sensor remained fully functional, although the charging port needed replacement. We observed that the measurements of oxygen, temperature, and force closely aligned with expected values based on different operational timings during the hauls. By adapting and deploying this technology in wild capture fisheries, real-time data on bottlenecks important for welfare and quality can be obtained, facilitating proactive management strategies.

SESSION 1	**Farmed vs. wild European plaice (*Pleuronectes Platessa*) - Nutritional, chemical, and physicochemical quality**

OP2

Name: Sophie Kendler **Organization:** NTNU

Authors: Sophie Kendler[1], Ozlem Yilmaz[2], Anita Nordeng Jakobsen[1], Anders Mangor-Jensen[2], Jørgen Lerfall[1]

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Abstract

This research aimed to investigate the nutritional quality of farmed European plaice to assess its potential as a new aquaculture species with regards to chosen quality parameters. In detail, the objective of the study was to investigate the differences in nutritional, chemical, and physiochemical quality of farmed European plaice with the quality of wild captured European plaice from Norwegian coastal waters. Additionally, both female and male individuals were compared to wild fish. Female and male individuals of were collected from the aquaculture research facility at the Institute of Marine Research, Austevoll. Wild European plaice was captured during three seasons along the west coast of Norway. The nutritional, chemical, and physicochemical quality was assessed as the water holding capacity (WHC), colour, texture, pH, proximate composition, and the amino acid and fatty acid profile. The analyses were conducted on each individual's upper loin and lower belly fillet to assess possible nutritional differences. The first results show significant differences ($P<0.001$) between WHC of wild and farmed plaice. Female fish had the lowest WHC, which can be linked to pre-spawning conditions. The lightness value L* indicates lighter fillets from farmed plaice than wild fish ($P<0.001$). The lipid content was significantly different ($P<0.001$), where male individuals showed the highest content of 2.35±1.5% and fish captured in April the lowest with 0.92±0.2%. Similar protein content was achieved compared to wild fish, ranging from 16% to 17%. Preliminary results on the quality of farmed European plaice promote further research on utilizing European plaice as aquaculture species. Results indicate higher fillet lightness of farmed than wild plaice, an attribute highly appreciated by customers. A higher lipid content of farmed fish was followed by a beneficial fatty acid profile. European plaice can be recommended for farming with regards to nutritional, chemical and physicochemical quality.

SESSION 1	How mycotoxins in aquafeeds affect animal condition and nutritional quality: gilthead seabream *Sparus aurata* as case study

OP3

Name: Patrícia Anacleto **Organization:** IPMA

Authors: Patrícia Anacleto[*1,2], Flávia Mello[2,3], Diana Cruz[4], Busenur Ozkan[1], Alícia Pereira[1], Cheila Pereira[3], Vera Barbosa[1], Ana Luísa Maulvault[1,2,5], Romina Gomes[1], Maria Paula Duarte[4], Narcisa Bandarra[1], José O. Fernandes[3], Florbela Soares[6], Pedro Pousão-Ferreira[6], Sara C. Cunha[3], António Marques[1,7]

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Abstract

Recent advances in aquafeeds promoted the use of plant-based ingredients with increased exposure to mycotoxins contamination that can affect the health of farmed fish and humans. Yet, the impact of mycotoxins in seafood nutritional quality is still unknown. In this context, this study aimed to evaluate mycotoxins effects in the nutritional quality of juvenile *Sparus aurata*. Two control (CTR; CTR-solvent) and three contaminated aquafeeds (fumonisin, FB1 - 139 µg/kg; enniatin B, ENNB - 154 µg/kg; FB1+ENNB - 121 + 130 µg/kg) were provided to fish during 28 days. Throughout the experimental period, fish were daily fed with 1.5% of their average body weight. In the beginning and end of the trial, three specimens per treatment were randomly collected, biometric data was registered and muscle was dissected. Samples were freeze-dried and analyzed for moisture, ash, free fat, fatty acids, crude protein and essential elements (potassium, sodium, magnesium, iron, copper, zinc and manganese) in fish muscle. Moreover, animal condition was assessed in terms of fitness and growth performance. Preliminary results show that aquafeeds contaminated with mycotoxins do not negatively affect fish weight gain and specific growth rate. In contrast, fatty acid composition, particularly EPA+DHA levels, decreases, which may compromise the nutritional quality of this species. Overall, this study provides new insights to understand and foretell mycotoxins impact on seafood nutritional quality and highlights the importance to undertake consumer risk-benefit assessment to accurately assess how they can be affected when eating farmed fish. Such information is crucial for the implementation of future regulations focused on mycotoxins in aquafeeds and for setting recommendations for consumers.

SESSION 1	**Ecotoxicological responses of juvenile gilthead seabream (*Sparus aurata*) exposed to mycotoxins**

OP4

Name: Flávia Mello **Organization:** IPMA

Authors: Flávia Mello[1,2]*, Cheila Pereira[2], Busenur Ozkan[3], Diana Cruz[4], Alícia Pereira[3], Ana Luísa Maulvault[1,3,7], José O. Fernandes[2], Florbela Soares[5], Pedro Pousão-Ferreira[5], Sara C. Cunha[2], António Marques[3,6], Patrícia Anacleto[1,3]

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Abstract

Currently, there is an increased risk of contamination by mycotoxins in aquafeeds due to the introduction of plant-based ingredients as a source of protein in the aquaculture. Besides causing toxic effects to fish health and consequently, promoting significant losses to the aquaculture sector, few studies have been performed on the effects of ingestion of mycotoxin-contaminated feed by fish. Thus, this study aimed to assess the ecotoxicological responses (metabolic and antioxidant activity, heat shock response, protein degradation, and neurotoxicity) of juvenile fish (Sparus aurata) muscle exposed to emerging (enniatin B, ENNB) and regulated (fumonisin, FB1) mycotoxins via feed. In vivo assays using a daily feeding with 1.5% of the average body weight (~62 g) of two control (CTR; CTR-solvent) and three contaminated aquafeeds with mycotoxins at 121-154 µg/kg, alone or in combination (FB1, ENNB, FB1+ENNB) were performed for 28 days. Fish muscle were sampled before (T0; n=6) and after the exposure period (T28; n=6 in each treatment). Overall, preliminary results showed an alteration of fish antioxidant mechanisms exposed to mycotoxins. The enhancement of CAT activity in FB1 treatment confirms the excessive formation of ROS induced by this stressor. In contrast, CAT, GST and TAC activities were inhibited in muscle from fish fed with ENNB and the mixture. Neurotoxicity and protein degradation was not observed in muscle fish after 28 days since acetylcholinesterase-AChE and ubiquitin did not differ significantly from control or T0. The metabolic activity of CS was reduced in muscle of fish treated with ENNB and the mix. Other biomarkers analysis is ongoing. Therefore, our results suggest an increased stress observed in fish contaminated by enniantin and the mix of both mycotoxins. Hence, this study highlights the relevance of performing multi-stressors ecotoxicological studies in order to better estimate animal health hazards posed by mycotoxins and contribute to decision-making for legislation.
This work was supported by the Project MycoFish - Occurrence, bioavailability and mitigation strategies for mycotoxins in farmed fish and associated feed ingredients: Gilthead seabream as case study (PTDC/CVT-CVT/2660/2021).

SESSION 1	**Eco-Innovative biofortified farmed gilthead seabream (*Sparus aurata*) and common carp (*Cyprinus carpio*): effects of processing on nutritional value**

OP5

Name: Vera Liane Ferreira Barbosa **Organization:** IPMA / FCT NOVA, Portugal

Authors: V. Barbosa[1,2,3]*, P. Anacleto[1,4,5], A. L. Maulvault[1,2,6], H. Oliveira[1,4], M. Ventura[2,7], P. Eljasik[8], R. Panicz[8], A. Karydas[9], P. Pousão-Ferreira[1], L. Carvalho[3], M. Martins[2] and A. Marques[1,4]

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Abstract

Farmed gilthead seabream and common carp are valuable commercial fish species produced in Europe. Seafood provides well-established health benefits to consumer through the availability of key nutrients (e.g., selenium, iron, iodine). Yet, globally, consumers intake of these essential nutrients is still below the recommended levels. Developing tailor-made farmed fish with adequate levels of essential nutrients through biofortification with sustainable ingredients (e.g., iodine-rich macroalgae and selenisedyeast) enables the supply of healthy and sustainable diets with adequate levels of target nutrients. This study aimed to evaluate the effect of steam-cooking and frozen storage on the nutritional value of biofortified fish fillets. Two diets – 1 control (CTR) and 1 biofortified (BF) with I-rich seaweed and Se-yeast – were fed to fish in the last 3-months of production, simulating a finishing diet. In the end, fillets from 15 fish were collected: one fillet stored for raw assessment and the other steamed (105 °C, 15 minutes). Additionally, 15 fish were collected and industrially frozen: glazed fish fillets (seabream) or whole fish (carp), being randomly packed and stored at –20 °C in a frozen chamber during 12 months. Results demonstrate that biofortified fillets enhanced the nutritional value (i.e., increased I and Se contents in seabream, increased Fe and Zn levels in carp) after steaming. Frozen storage did not significantly affect the nutritional value of bofortified fillets, except reduced I (seabream) and Se (carp) levels, as well as increased lipid oxidation and decreased water-holding-capacity. Major changes in colour and texture occurred after 45 days (seabream) and 225 days (carp) of storage. This study provides new insights to validate farmed fish biofortification strategies to improve seafood production, security and nutritional value using sustainable ingredients.

SESSION 1	Biological variation of Greenland halibut (*Reinhardtius hippoglossoides*) – Optimization of sustainability, quality and commercial value (*Qaleralik*)

OP6

Name: Natacha Leininger Severin **Organization:** University of Copenhagen

Authors: Natacha L. Severin[1], Niels Bøknæs[2], Aviaja L. Hauptmann[3], Jesper Boje[4,5], Per Kania[1], Kurt Buchmann[1]

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Abstract

'Jellied' flatfish are seen in commercial fisheries in both the North Atlantic and North Pacific. The phenomenon is also well known in the Greenlandic halibut fishery. In the few existing studies, affected halibut are referred to as 'mushy' or 'gelatinous', while locals simply refer to them as 'jelly fish'. All these nicknames pin-point the issue: flesh that, for reasons unknown, attains a jelly-like, watery and soft texture, and turns to 'mush' when cooked. The inferior quality of 'jellied' fish products leads to both economic and raw material losses. In Greenland, the species is of high commercial value and of paramount importance to the country's economy. Therefore, ensuring stable quality and minimizing customer dissatisfaction is crucial. The goal of this Ph.D. project is to explore the 'jellied' condition in Greenland halibut more in depth. We will investigate histoarchitecture, proximate chemical composition and yield of affected and unaffected fillets of commercially caught fish from the Greenlandic fishery. Furthermore, we will explore a potential parasitic etiology as well as association with geography and biological factors. Finally, commercially available technologies for early detection of affected products will be tested. Knowledge on the phenomenon's structural and biochemical characteristics, possible etiology and detection options will aid optimization of fishery strategies and encourage more sustainable quota exploitation.

SESSION 1	Eurofish International Organisation – for the development of fisheries and aquaculture in Europe. Research and development activities

OP7

Name: Marco Frederiksen **Organization:** Eurofish International Organisation

Authors: Marco Frederiksen

Eurofish, non-profit independent sister organisation of FAO. By EU a recognized International European Research Organisation for Horizon Europe. Eurofish supports the develop of the fisheries and Aquaculture sectors in Europe and publish the "Eurofish Magazine". Main activities: − Dissemination activities at conferences, workshops, field trips, Eurofish Magazine, and specialised Industry/educational guides. − Participation and coordination in several research and development projects.

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Abstract

Selected current research and development activities: i) Eurofish coordinates the SmartAqua4FuturE (SAFE) project with 13 partners. The aim is to reverse the declining trend of EU freshwater aquaculture by demonstrating a circular economy model that reduces emissions, minimizes impacts on biodiversity, supports local production of sustainable feed ingredients, improves profitability, and creates new jobs. Here, the main objective is to reduce the environmental impact and improve the viability of freshwater aquaculture. ii) The AlgaeProBANOS project will create a lighthouse in the Baltic and North Sea for accelerating algae product development and de-risk the industry. This to increase accessibility and availability of sustainable and innovative algae products and services in the European market and beyond. Eurofish will develop algae market in the EU. iii) The FishEUTrust project purpose is to defragment the current food system to ensure sustainability and deliver solutions for a transparent and traceable seafood supply chain necessary to promote high-end, pan-European farmed seafood. FishEUTrust will establish five Co-creation Living Labs (CLLs). Eurofish will create sustainable business models for aquaculture and develop tools for maximizing trust by guaranteeing the quality, safety, and traceability of seafood products. Within the next four years results will be disseminated by Eurofish through dedicated projects websites, the Eurofish Magazine and at conferences and events.

SESSION 1	Sustainable fish production through insect-powered feed processing: modeling and optimization of resource, process and quality parameters

OP8

Name: Aberham Hailu Feyissa **Organization:** DTU

Authors: Aberham Hailu Feyissa[1]*, Anna Thorsteinsdotti[1], Stell J. Højberg[1], Kyla M. Zatti[2], Hongyuan Cheng[1]

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Abstract

As fish production faces increasing demands, insects emerge as a transformative protein source, posing technological challenges while offering sustainable and efficient methods to meet the growing needs of the aquaculture industry. This work aims to develop a model and optimize the incorporation of insect meals, particularly black soldier fly (BSF) and mealworms (MW)), and processing conditions on the pellet quality: bulk density (BD), hardness, water stability (WS), oil absorption capacity (OAC), losses, etc and thereby to improve the feed for salmon production. The feeds were formulated with varying levels of insect meals and processed under varying process conditions (e.g., screw speeds, die temperatures, moisture) encompassing more than 54 combinations using a pilot-scale twin extrusion system. After production, each pellet was subsequently processed, and followed by a comprehensive evaluation of all relevant quality parameters. Diverse modeling approaches: machine learning (neural networks, ANN, and response surface methodology, RSM), alongside phenomenological, were applied to optimize and predict the quality. The models well predicted the pilot-plant data and the prediction results have revealed intriguing nonlinear impact of the parameters under investigation, resulting in new insights. A portion of the results: the BD in the presence of MW is nonlinear, influenced by both MW and temperature. The impact of MW on OAC is highly dependent on temperature, while the hardness increases notably with rising MW content up to a critical level, however beyond the threshold, the hardness gradually decreases. The increase of BSF levels increases the WAC before reaching peak values and afterward declining. WS rises significantly with increasing temperature and BSF. Promisingly, integrating insect meals, enhancing fish pellet properties, and fostering sustainable fish/aquaculture production. To achieve optimal replacement levels, meticulous fine-tuning of process conditions is imperative. Utilizing models (digital twins) provides valuable insights and accelerates the identification and rigorous testing.

SESSION 1	The effects of ingredient formulation with insect meal on the rheological properties of fish feed melt

OP9

Name: Anna Thorsteinsdottir **Organization:** DTU

Authors: Anna Thorsteinsdottir and Aberham Hailu Feyissa

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Abstract

Modern fish feed production for the aquaculture industry requires the use of resources that are scarce and costly, as fisheries have effectively minimized product loss. With the increasing emphasis on sustainability, understanding the extrusion process could increase ingredient utilization and production efficiency. The objective of this study was to understand the rheological properties of fish feed melt and how changing the extrusion conditions and the formulation of ingredients can influence the characteristics of the melt within the barrel. An experimental design was applied and the changes in the melt´s properties were measured using a rheometer and rapid viscometer (RVA). The effects of process conditions, and insect meal were used as an independent variable to explain the relationship between ingredients, extrusion conditions and the rheological properties of the melt. The data was processed to evaluate the correlation between parameters. The rheological properties of fish feed melt with insect meal was significantly different from the traditional recipe and depends on the level of substitution. Traditional recipes of fish feed with fish meal show shear thinning properties and pseudoplastic behavior. When insect meal is used, there is less heat and pressure created within the system as the oil acts as a lubricant, reducing friction between the melt and the barrel wall and screw. The oil and the increased fiber content could therefore significantly affect the expansion potential of the melt, as the sudden evaporation of water at the die depends on these parameters. Implying that when including insect meal, the recipe formulation would need to be adjusted in relation to ingredient formulation. The obtained results provide a better understanding of the rheological properties of new ingredients in the formulations and their effect on the physical quality of fish feed pellets. The results will support the industry to improve the feed manufacturing process.

SESSION 1	Utilisation of water and blood to improve sustainability of land-based salmon aquaculture.

OP10

Name: Sæmundur Elíasson **Organization:** Matís

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Abstract

The objectives of the study are twofold: A) to minimize wastewater generated by land-based salmon aquaculture and B) to explore a novel method for capturing and utilizing salmon blood from the slaughtering process. The assessment of water utilisation focuses on the key waterflow streams within land-based aquaculture facilities. The physicochemical characteristics and properties of these streams are analyzed to improve water reuse, filter out dry matter and minimize wastewater production. In the slaughtering process, a novel technique involving dry-bleeding of salmon and capturing undiluted blood before the conventional wet-bleeding method is being investigated. This evaluation includes: i) determining the optimal duration and dry-bleeding rate for the salmon, ii) assessing any potential negative impact of the dry-bleeding process on fillet quality, and iii) identifying the most effective method for collecting and processing the blood to obtain valuable by-products. The study results in various measurements for filtered land-based aquaculture water streams, such as microbial, chemical, and physical analyses. Additionally, the results show valorisation options for the filtered dry-matter. Results for the utilization of salmon blood and the effects of dry-bleeding on fillet quality, include captured images of the fillets, analyzing color components using hyperspectral imaging, measured hemoglobin levels, and evaluation of shelf life through microbial measurements and Total Volatile Nitrogen (TVN) analysis. Overall, the chemical composition of the recoverable water and dry matter from aquaculture shows potential for re-circulation, valorization processes and waste reduction. The results on salmon blood utilization evaluates the challenges of blood collection methods, assessment of dry-bleeding effects on salmon fillet quality, and the valorization potentials of salmon blood.

SESSION 1	Chub mackerel and quinoa improve liver DHA status in Alzheimer disease: an opportunity for the upgrading of undervalued fish species

OP11

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Abstract

The relevance of docosahexaenoic acid (DHA) for neuronal health has been reported, and lower levels of this fatty acid were related with the cognitive decline during ageing process and neurological disorders, like Alzheimer Disease (AD). Reinforce DHA ingestion is advisable to counteract this, yet little is known about its metabolic fate in individuals with AD. This work aimed to evaluate the liver lipid fraction and DHA status of mice with AD fed with a diet containing foods with neuroactive nutrients: chub mackerel (DHA and vitamin B12) and quinoa (vitamin B9). For this, 32 transgenic mice [5xFAD (B6SJL)] with 1 month old were assigned to 4 groups, fed for 5 months with distinct diets: control (AIN-93M standard rodent diet), M group (AIN-93M with 10% chub mackerel), Q group (AIN-93M with 5% quinoa), and M+Q group (AIN-93M with 10% chub mackerel plus 5% quinoa). Total lipids content (TL), lipid classes (LC) and DHA relative content were determined. The highest TL was found in M+Q group (12.9±7.7%), nevertheless no significant differences were observed between groups. For LC, triacylglycerols (TAG) and phospholipids (PL) were the most relevant. While TAG prevailed in Control and Q groups, PL predominated in M group. The highest PL contents were found in M+Q group. In turn, FFA were more abundant in Control group. M+Q group had the highest DHA relative contents (12.2±2.8% of total fatty acids), followed by M group (7.6±3.8%). Significant lower DHA relative contents were found in Control and Q groups (3.8±1.2% and 3.2±3.1%). To conclude, diets containing chub mackerel and combining chub mackerel with quinoa, led to higher PL amounts in livers of mice with AD, and revealed an increased DHA uptake, showing that the supplementation/food might be beneficial to modulate lipids uptake while improving liver DHA status in patients suffering with AD.

SESSION 1	New strategies for mitigating undesirable odors of geosmin and 2-MIB in freshwater fish products

OP12

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Abstract

Fresh hybrid catfish (Clarias macrocephalus × Clarias gariepinus) fillets have a distinct earthy odour linked to trans-1,10-dimethyl-trans-9-decalol (geosmin) and 2- methylisoborneol (2-MIB). Tentative routes to mitigate these undesirable odour problems are to remove them from the matrix, convert them to odourless compounds, mask their odour or chelate/bind them with other molecules to make them less volatile. For example, in the presence of organic acids at pH 1-3, geosmin and 2-MIB are converted to the odourless argosmin and 2-methylenebornane, respectively. The goal of this study was to evaluate whether the release of geosmin and 2-MIB in fish could be reduced by adding polysaccharides, organic acids or biomasses enriched in these compounds. Alginate, carrageenan, pectin, cyclodextrins (CDs), citric acid, rosmarinic acid, tannic acid, benzoic acid, carnosic acid, ascorbic acid and isoascorbic acid were added into geosmin- and 2-MIB-spiked washed cod mince at levels aligned with the maximum acceptable daily intake (ADI) set by EFSA. Red seaweed (Palmaria palmata) and juice press cakes from apple (APC) and lingonberry (LPC) were added to the spiked washed cod mince at 5 and 10% (dw/dw). Geosmin and 2-MIB were analyzed using solid phase microextraction (SPME)-GC-MS. None of the compounds or biomassestested so far have reduced geosmin volatility. However, pectin and alginate (3.85% (ww/ww) each) prevented 49% and 18% of the 2-MIB release, respectively while CDs (0.58%) reduced the 2-MIB-release by up to 60%. Five and 10% of APC and LPC decreased the release of 2-MIB by 25-46%. Palmaria significantly increased the release of both geosmin and 2-MIB, possibly due to high salt. Results from additional analyses will also be presented. This work provides initial ideas for mitigating off-odour issues in commuted products from freshwater fish species. Moreover, the study stimulates a sustainable use of food side streams which today leave the food chain, despite being rich in nutrients and molecules providing important food functions.

SESSION 1	Assessment of the nutritional quality indexes of lipids in meagre fish, sea bream and octopus

OP13

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Abstract

The European Horizon Sea2See project (https://sea2see.eu/) aims at increasing consumer confidence and acceptance regarding sustainably fished or farmed seafood in Europe. Quality, safety and nutritional indexes of octopus, sea bream and meagre were evaluated in this study. Wild octopus was caught from Algarve (south of Portugal) by Portuguese fishing vessels. Meagre was farmed using a Recirculating Aquaculture System, in SEAentia (Peniche, Portugal). Sea bream was produced in Greece through sustainable aquaculture. The main goal of this study was to arrive to relevant considerations about the nutritional profile of these seafood on human health. Parameters of food quality and safety, as well as emergent contaminants and benefits were evaluated. Analyses were performed according to official methods or recommended procedures. In particular we focused on characterization of lipids as nutritional and health indexes. Fatty acids can help in the onset of certain diseases depending on their nature (double bonds and position), while polyunsaturated fatty acids (PUFAs) may have beneficial actions on cardiovascular, neurological and allergic diseases. In this context, different indexes were studied: PUFA/SFA (saturated fatty acids), Index of Atherogenicity (IA), Index of Thrombogenicity (IT), Hypocholesterolemic/Hypercholesterolemic (hH), Linoleic/Linolenic Acid (LA/ALA), Omega 6/Omega 3 (w6/w3), Linoleic Acid/Linolenic Acid (LA/ALA) ratio and Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA) percentage (EPA+DHA %). Microbiological, chemical, toxicological parameters (including legislated and emergent contaminants), as well as freshness and quality indicators offered very good results, all complying with the legislation. Nutritional and sensorial analyses show high quality values and testers acceptance. The indexes of nutritional quality of lipids IA, IT and w6/w3 offered very low values representing positive effects for humans. In contrast, hH ratio, PUFA/SFA, EPA+DHA % and LA/ALA showed high values, which confirms that these sea products can be considered of high quality and good potential as nutritional food with beneficial effects for the consumer´s health.

SESSION 1	Simulated digestion of red sea cucumber (*Parastichopus tremulus*) – protein quality and antioxidative capacity

OP14

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Abstract

The aim of this study was to determine the protein quality and analyze the antioxidant activity of whole, and freeze-dried red sea cucumber (Parastichopus tremulus) of peptides released during a simulated digestion model. Red Sea cucumber were harvested during Autumn 2020 using a bottom trawler by the Gunnerus research ship in Trondheim's fjord. Twenty red sea cucumbers were divided into two groups: whole (n=10) and freeze-dried red sea cucumber (n=10). Proximate composition was analyzed and protein quality evaluated based on amino acid composition. The simulated gastrointestinal digestion was conducted by adjusting pH and addition of enzymes. The antioxidant activity was measured by Ferric reducing ability of plasma (FRAP), 2,2'-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) and oxygen radical absorbance capacity (ORAC), at start, after 30, 60, 75, and end (165 minutes) of digestion. The proximate composition of whole and freeze-dried P. tremulus are similar to previous studies. The %true retention in freeze-dried P. tremulus, range between 126% to 152% of the total amino acids profile. In general, the protein in both whole and freeze-dried P. tremulus had a higher content of essential amino acids content compared to the reference protein. Both whole and freeze-dried P. tremulus exhibited little antioxidant capacity. Whole P. tremulus had an increase of antioxidant capacity during the digestion process. Freeze-dried P. tremulus showed no increase in antioxidant capacity during digestion except for the antioxidant assay of ORAC. Whole and freeze-dried P. tremulus could hence potentially contribute to the umami-taste and be used as a food additive. Whole and freeze-dried P. tremulus had little, but showed potential to have antioxidant activity. However, more studies are needed on the antioxidant activity of both undigested and digested P. tremulus.

SESSION 1	Alginate and cuttlefish ink-based caviar-like hydrogel beads as alternative to sturgeon caviar: Comparison of physicochemical properties

OP15

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Abstract

Caviar is obtained from the roe of sturgeon fish of the Acipenseridae family and has a delicacy with high nutritional. The sturgeon's maturation period for obtaining roe takes long time and cannot meet market and consumer demand in recent years. Modern food processing techniques such as alginate hydrogel spherification technique is an alternative to produce caviar alternatives. In this study, caviar-like hydrogel beads as alternative to sturgeon fish caviar were produced from alginate hydrogel and cuttlefish ink using spherification technique. In order to develop sturgeon caviar alternative melanin-free ink (MFI) was extracted from processing waste of cuttlefish and added to alginate mix as antioxidant, colorant and fishy flavor. Physicochemical properties of caviar-like hydrogel beads produced from alginate by mixing MFI were compared with commercial caviar product. MFI ink contributed to taste, color and appearance of the caviar-like beads. In addition, caviar-like hydrogel beads produced in this study had long shelf life due to the antioxidant and antimicrobial properties of MFI. Our results suggested that the caviar-like beads made from alginate and MFI could be an alternative for sturgeon caviar with its functional properties and lower cost. Besides, the production of caviar-like hydrogel beads from alginate and cuttlefish ink can provide an opportunity for the sustainability of sturgeon farming by reducing the original caviar production.

SESSION 2	Seaweed market barriers in the food legislation- a need for a more balanced view on seaweed benefits and risks

OP16

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Abstract

Currently, the toxic elements (PTEs) in seaweeds are potential market barriers in Europe, and the absence of maximum levels on using seaweed as food complicates the situation. which has resulted in recommendations to the European Commission. More data needed! But the market is still waiting for the legislative actions and establishment of maximum levels. Recently two reports were published; a FAO report1 and a Nordic Food Authority report2 on current status and future perspectives within seaweed food risk assessment and safety. These reports can either be welcomed or criticized for (once again) showing the risks without including data on the health beneficial compounds in seaweeds. Consequently, these reports may contribute to harming the reputation of seaweed as a food resource, and you can ask if similar exercises have been performed on other foods for comparison? There is therefore a need for a more balanced view on the use of seaweeds in food (and feed) applications and hopefully future national and international reports will include both the benefits and the risks? This presentation will give an overview of the current research, legislation and standardization activities within seaweed chemical food safety and how to navigate in a “non-legislative” market.

OP17

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Abstract

Seaweed cultivation is the fastest-growing form of aquaculture; however, it is still an underutilized resource. Some of the key challenges in developing the seaweed industry are to scale up seaweed cultivation and processing into price-competitive product applications making the entire supply chain attractive for commercial investments. To achieve this the seaweed industry needs to develop new food and feed products, which can be risky. One way of reducing this risk is to combine new product development efforts with good business models and go-to-market (GTM) strategies (Kuester et al., 2018). This research aimed to identify opportunities and barriers to developing food and feed products from farmed macroalgae, by analysing the GTM strategies of 3 seaweed producers. The analysis of GTM strategy was based on semi-structured expert interviews with companies producing food products from macroalgae. 3 types of food and feed products were identified from fucoidan, beta-glucans and alginates. The opportunities as first movers and only Western producers in growing markets are strengths to be utilized. Food and feed products from farmed macroalgae fit global trends such as natural, clean label and sustainable, in addition to functional food and feed. The barriers to the small seaweed producers are to scale up production and reduce production costs. Several of the products under development are already available from other sources. Finally, validating positive health effects is important to differentiate seaweed products from competitors. For feed health claims are not allowed in the EU. In conclusion, producing food and feed products from farmed macroalgae fit global trends and target growing market segments. However, competition from substitutes, lack of health claims and high production costs are barriers to success.

SESSION 2	**Effect of dehydration, rehydration and thermal treatment on the bioactive, nutritional and sensory profiles of red seaweed *Porphyra umbilicalis***

OP18

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Abstract

Seaweeds are considered to be one of the most promising sources of sustainable food. Their nutritional value is widely recognized and they are also a valuable source of bioactive compounds with health benefits. Therefore, seaweeds can be used as ingredients for the formulation of nutraceuticals, functional foods and also as whole food for direct human consumption. However, pre-treatments and processing methods can affect these properties as well as the palatability of seaweeds and seaweed-based products. The purpose of this work was to evaluate the effect of dehydration (at 30 ºC, 10% relative humidity, during 4-4.30h), rehydration (at 20 ºC) and thermal treatment (at 90 ºC, 10 min.) on the bioactive, nutritional and sensory profiles of wild red seaweed Porphyra umbilicalis, harvested on May 2021 in Figueira da Foz (Portugal). All samples (fresh, dehydrated, rehydrated and heated) were freeze-dried for chemical analyses: elemental and amino acids composition, bioactive compounds content, antioxidant (DPPH, ABTS) and antiAlzheimer activities, which were determined according to reference methods. Sensory properties were assessed by descriptive quantitative analysis using a trained assessors. Overall, dehydration, rehydration and thermal treatment caused in a different extent a decrease on the of carotenoids and TPC contents, on the ABTS and DPPH radical scavenging activities and on the inhibitory activity, although a relatively high acetylcholinesterase inhibitory activity was observed (from 40% to 90%). Regarding phycobiliproteins (characteristic of red seaweeds), high levels of phycoerythrin, phycoerythrocyanin and phycocyanin were found on fresh and dehydrated samples. In relation to mineral elements, the following profile K>Na>Mg>Fe>Zn>Mn>Cu was obtained for fresh and dehydrated seaweed. Rehydration and thermal treatment caused a decrease on the content of some elements, namely K, Na, Fe, Cu and Mn. Amino acids (total and free) analyses are still in progress. Sensory data evidenced a positive effect of thermal treatment on the palatability of seaweed.

SESSION 2	The effect of freezing and thawing on *Alaria esculenta*

OP19

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Abstract

Freezing is a popular method for long term food preservation which generally preserves taste and nutritional value. However, freezing and thawing of seaweed has been shown to cause a substantial loss of liquid. In this study, the effect of freezing and thawing on the nutritional value of Alaria esculenta was evaluated. This was done by determining the moisture, dry matter, ash, protein, amino acid and carbohydrate contents of the drip loss, raw material, and leftover raw material. Additionally, a supplemental experiment was conducted to further investigate the loss of minerals and effects of different freezing and thawing methods. The seaweed was frozen and thawed in four different ways, combining quick and slow freezing and thawing. The mineral content of the leftover raw material and drip loss was analysed. The drip loss in the experiments ranged from 18-55%. The highest drip loss was observed in the initial experiment where industrial bulk frozen A. esculenta was thawed with continuous draining of the drip loss, while the lowest drip loss was observed for the quick freeze samples thawed in bags. The drip loss from the first experiment contained 6.6% dry matter, of which 71% was minerals. The analyses showed that mannitol and free alanine, as well as some free glutamic and aspartic acid was lost to the drip loss. The results from the additional experiment showed that quick freezing is the best method for reducing drip loss. However, analysis showed that slow freezing contributed to the release of more iodine into the drip loss which is favourable if the raw material is meant for human consumption. Altogether, the nutritional composition of the seaweed did not seem to be substantially affected except for the favourable reduction of iodine. However, loss of mannitol, alanine, glutamic acid, and aspartic acid could alter the flavour profile.

SESSION 2	**Physicochemical- and bioactive properties of acid preserved *Alaria esculenta* and *Saccharina latissima* during storage**

OP20

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Abstract

Seaweed used for food and feed applications today are generally minimally processed, where they are mainly dried or frozen to reduce deterioration of the biomass. In Europe, the harvesting time of cultivated seaweed is very short, or about one to two months each year. The short harvesting period can make it difficult for seaweed cultivators to provide their customers with high quality seaweed biomass all year around. Therefore, to ensure a yearround supply of cultivated seaweed biomass there is a need for novel processing and preservation methods. Objective and methods: Acid preservation is a well-known method to preserve food, where the aim is to reduce the pH below 4.5 to inhibit microbial growth. To evaluate the effectiveness of acid preservation as a preservation method for seaweed, a shelf-life experiment was conducted with the two most cultivated species of brown seaweed in Europe, Saccharina Latissima and Alaria Esculenta. The biomass was either treated with lactic- or citric acid and stored over approximately six-month period. Physicochemical (including proximate composition, trace minerals, total phenolic content (TPC), texture and pH), microbial-, and antioxidant (ORAC, DPPH) analysis were performed during storage and sensory attributes of the preserved biomass examined to evaluate possible uses of the biomass for food applications. Results and conclusion: Results showed that the proximate composition, color, pH, and texture of the acid-preserved seaweed were relatively stable throughout the storage time. However, a decrease was observed in TPC and antioxidant properties (assessed by DPPH) during storage of the acid preserved biomass. The method might, thus, be good to stabilize the biomass for food and feed applications but not if intended for antioxidant purposes. However, the acid treated biomass might be suitable as an ingredient for value-added products.

SESSION 2	Effective preservation of seaweed and the impact on properties of importance for use as food ingredient

OP21

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Abstract

Cultivated seaweed has a short harvesting season and preservation is needed. Ensiling by acid addition or fermentation by lactic acid bacteria are methods currently being explored in research and by seaweed farmers. Results from fermentations have varied, where the pH-decrease has sometimes been insufficient to avoid spoilage. The aim of this work has been to investigate how fermentation rates and final pH are affected by differences in biomass composition and different handling of the biomass, and how the storage at low pH affects properties of importance for use as food ingredients. Design The buffer capacity of *Alaria esculenta* and *Saccharina latissima* harvested in Norway at different times between April and June were compared, and fermentation trials with Lactobacillus sp. were performed to determine the initial acid production rates. Acid-preserved and fermented biomass were stored for up to 7 months, with accompanying analyses of changes in biomass components. Results, discussion and conclusions During the harvesting season from April to June, the biomass dry weight increased, and the ash content decreased, due to accumulation of storage carbohydrates. Our hypothesis was that these changes would be the main factor affecting the fermentation. However, observed batch variations for the acid production did not correlate solely with the biomass composition. Other factors contributing, involved the native microbiota, and the time and storage conditions before adding the starter cultures. Different commercial starter cultures are currently being screened, with emphasis on cultures that grow well below 20°C. During the long-term storage of biomass preserved with added organic acids at pH 3.7-4.5, the molecular masses of the seaweed polysaccharides gradually decreased, and changes were observed also in other components. Based on the results, our intention is to establish guidelines for choice of preservation method and handling of the biomass from harvesting until start of the preservation.

SESSION 2	Salt pickling as a post-harvest treatment to prolong shelf-life of sugar kelp (*Saccharina latissima*)

OP22

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Abstract

Sugar kelp (*Saccharina latissima*) is a Nordic species of brown macroalgae, which has increasingly become of interest for food consumption in the Western countries over recent years. Untreated kelp has a short shelf-life unless subjected to frozen storage. This in combination with a short harvest period creates a bottleneck for food producing companies. Immediate post-harvest treatments to prolong the shelf-life of kelp are essential to avoid food waste, with the energy-intensive drying commonly used. Research into less energy-intensive ways to treat kelp is needed to guide kelp producing companies. Here, we tested the effect of six post-harvest treatments with varying levels of added NaCl (0, 5, 10, 15, 20, and 50% w/w) on the shelf-life of sugar kelp at 3 °C. The treated kelp was evaluated regarding sensory properties (odour), microbial and physicochemical quality during storage. The following findings from this on-going study are based on the first 19 days, and at the conference, findings up to 150 days post-harvest storage will be presented. Addition of ≥15% NaCl inactivated initial microbial counts from 5.5 to ≈2 log10(CFU/g) with regrowth inhibited, while 10% NaCl reduced initial counts to 3-4 log10(CFU/g). Treatments with 5, 10, 15, 20, and 50% added NaCl reduced the initial water activity (aw) for fresh sugar kelp of 0.99 to stable aw levels at 0.95, 0.90, 0.87, 0.79, and 0.75, respectively. The loss of greenness of sugar kelp were significantly ($p<0.05$) reduced by addition of NaCl, which resulted in more negative a* (green) scores compared to the untreated control, regardless of NaCl concentration. While the untreated control sample developed noticeable off-odours after 6 days (score ≥2, out of 3), all other treatments have remained acceptable (i.e., no off-odours) for 19 days. This study shows the promise of preserving sugar kelp by salt pickling and refrigerated storage.

SESSION 2	Fermentation of seaweed for seafood products and evaluation of product quality, shelf-life, and bioactivities

OP23

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Abstract

Fermentation is a well-known process, used in the food industry for centuries to improve product shelflife or physical properties. There is an increasing demand from the consumers for fermented products due to their known health effects and higher digestibility. Seaweed is a sustainable source of valuable compounds for human nutrition such as carbohydrates, proteins, lipids, and minerals. However, few seaweed-based fermented products are available in the European market. Several challenges of seaweed fermentation have been reported due to their microflorae and chemical compositions. The aim of this study is to assess and optimize the fermentation process of sugar kelp (Saccharina latissima) and to evaluate its addition into a seafood product (fish cake) by sensory properties, shelf-life and bioactivities of the final product. To identify the optimal fermentation conditions of sugar kelp, eight different conditions were tested: varying the pre-processing factors (blanched and fresh), cultures (two different cultures of Lactobacillus plantarum) and temperatures (room temperature and 37 °C). pH levels were measured regularly to monitor the fermentation process. The pre-processing, starter cultures and temperatures influenced the fermentation process in several ways, and fermentation of blanched seaweed at 37 °C can provide a shelf-stable product of suitable sensory characteristics. Kelp fermented by the optimized method was added into a fishcake and was evaluated by self-life of the final product: oxidation (TBARS, PV), microbiological spoilage, texture profile analysis, quality index method and sensory parameter modification (color, odor, texture) were followed in time. Several in vitro bioactivities (antidiabetic, antihypertensive and antioxidant) were also analyzed to screen potential health effects of the fermented kelp as well as of the fish cake and to assess how the kelp's benefits are impacted in the processed product. This study shows future opportunities for fermented seaweed in food products for the European market. Further results will be presented.

SESSION 2	**Sensorial properties of *Arthrospira platensis* and it´s extracts enhanced by different heat treatments or enzymatic hydrolysis**

OP24

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Abstract

The global human population is growing, and it is estimated that the demand for proteins will double by 2050. Therefore, there is a major need to find new sources of high-quality and sustainably produced proteins. Microalgae have been identified as one of the promising sources of alternative proteins. Arthrospira platensis, usually called spirulina, represents an important source of proteins and other essential nutrients. The sensorial properties of spirulina can though be a drawback. The aim of the project was to affect the negative sensorial properties by use of heat treatment with or without enzymatic hydrolysis. Methods The raw materials used where all processed by VAXA technologies Iceland. Samples uses were dried biomass, blue (water soluble) and green (non water soluble) fractions extracted from the biomass. These two fractions and the original biomass were hydrolysed (5% protein solution) by using the enzyme Protamex® from Novozymes at E:S ratio of 1:50, incubated for 30 minutes at 45°C followed by inactivation at 90°C / 15min. For heat treatments the samples were heated for 30 minutes at 45°C, at 90°C for 15 minutes, for 30 minutes at 45°C + 15 minutes at 90°C, for 45 minutes at 45°C and finally at 45°C for 60 minutes. After treatment the samples were freeze dried. First samples were taken for analysis of Degree of hydrolysis with TCA method and SDS. Furthermore, Total Phenolic content (TPC) was analysed. Sensorial analyses were performed by trained panel (n=8) by the GDA method. The results showed that heat treatment was more efficient in minimizing spirulina taste then enzymatic hydrolysis. Conclusion Heat treatment of different *Arthrospira platensis* biomass and extracts showed an effect of their sensorial properties, showing that processing can have a positive affect on their use as an alternative protein source.

SESSION 2	Formation and characterization of sodium alginate/sodium caseinate nanoparticles for curcumin

OP25

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Abstract

Curcumin (CUR) is a polyphenol extracted from turmeric possessing antioxidant, anticancer, anti-inflammatory and anti-aging activities. However, CUR has low solubility and undergoes rapid degradation. The interaction of the two major food biomacromolecules protein and polysaccharide has gained recent attention as a potential delivery system for CUR. Materials and methods: We have studied protein-polysaccharide interaction of sodium caseinate (NaCas) and sodium alginate (Alg) in the presence of citric acid (CA) (2%, w/w), as function of pH, total biopolymer concentration (TBC), molar ratio of NaCas to Alg. The binding characteristics of NaCas, Alg and NaCas-Alg with CUR were studied by fluorimetry technique, as well as in terms of particle size distribution and zeta potential by dynamic light scattering. The encapsulation efficiency and stability of NaCas-Alg with CUR were studied for up to 8 days at room temperature at different CUR and Alg concentrations. Finally, the effect of NaCas-Alg on CUR antioxidant activity was be studied. Results and discussion: The fluorescence study demonstrated improved binding of CUR with NaCas in CA as well as interaction with Alg possibly due to cross linking. The NaCas/Alg molar ratio affected CUR stability demonstrating different destabilization mechanisms, also influenced by CUR concentrations. The charge neutralisation was observed at NaCas/Alg molar ratio 5 at pH 3.5 where the particle size distribution indicated the formation of larger aggregates, molar ratio 20 exhibited a homogeneous particle distribution with PDI ~0.2 and reduction in particle size with CUR. In addition, the effect of pH and TBC on NaCas-Alg interaction and CUR encapsulation will be discussed in detail. Conclusions: NaCas - Alg interaction as affected by pH, TBC, NaCas to Alg molar ratio determined the final efficiency and stability of CUR encapsulation in NaCas – Alg nanoparticles.

SESSION 2	Usage of microalgae as seafood flavoring agent

OP26

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Abstract

The aim of this study is to evaluate the seafood flavoring potential of microalgae in two plant-based products: a plant-based seafood broth and a plant-based mayonnaise (veganaise). A broth was prepared using Tetraselmis chuii biomass which flavor features were compared with broths containing a commercial vegan fish flavor and two animalbased seafood flavorings. Additionally, veganaises using Tetraselmis chuii and Rhodomonas salina as flavoring agents were made and compared with the seafood flavorings. Sensory evaluation by trained panel was conducted to assess the sensory features of the food products, whereas the overall acceptability of the products were evaluated by a consumer panel. Sensory evaluations of the food products showed that both Tetraselmis chuii and Rhodomonas salina possess strong seafood flavoring capacity. The consumer evaluation revealed that the broth made with Tetraselmis chuii had a similar overall acceptability score compared to the animal-based seafood flavorings. Furthermore, Rhodomonas salina can provide seafood flavor to the veganaise without affecting the general appreciation of the original product. Incorporating microalgae into plant-based seafood alternatives can offer an innovative solution to meet consumer demand for sustainable and healthy food options while still delivering authentic flavors associated with seafood. Further research is needed to investigate the behavior of the microalgae flavor in food products during food processing and storage. This would provide important information about the shelf-life of the plantbased food products and further help in the development of plant-based seafood alternatives.

SESSION 2	Do benefits outweigh risks in seaweed as food? Case-study assessment with integration of bioaccessibility information

OP27

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Abstract

Seaweed (SW) is an undervalued resource that may meet consumer demand for sustainable and healthy food. SW is a source of iodine (I) and other nutrients with a positive health impact. However, there are SW constituents with a deleterious effect, namely the consumption of some SW species may entail a risk derived from too high I or from contaminants, such as arsenic (As). Accordingly, on the basis of case-studies, this study aimed to assess the balance between risks and benefits (RB) in consuming particular seaweed species. Material/methods/design A set of cultivated and wild SW species, including green (Rhizoclonium riparium and three Ulva species), brown (Petalonia binghamiae, Halopteris scoparia, Fucus spiralis and Saccorhiza polyschides), and red (Pterocladiella capillacea, Osmundea pinnatifida, Asparagopsis armata and A. taxiformis) SW, were selected for this study. Proximate composition, fatty acids (GC), and elements (ICP-MS) were determined using standard methods. Rehydration and steam cooking effects were studied. Bioaccessibility was assessed by an in vitro model simulating human digestion. An Extreme Value Theory (EVT) approach enabled to evaluate risks and benefits by calculating the probability of exceeding specific dietary recommendations or safety thresholds. Results and discussion Firstly, results highlighted the very specific nutritional properties of SW. Studied species contained high levels of essential elements, particularly I in brown and red SW. Non-essential elements (Hg, As, Cd, and Pb) had generally low contents and only presented a concern in particular species, for instance excessive I in A. armata and A. taxiformis. In several instances, such concerns remained after considering bioaccessibility data, for instance, due to high As bioaccessibility in P. binghamiae (> 50%). EVT enabled to quantify such risks and ensure that they were really very low in almost all studied cases. The performed RB analysis enabled to issue advisable consumption frequency intervals for different seaweed species.

SESSION 2	**Seaweed and chub mackerel hamburger: a functional food for preventing cognitive decline by enhancing bioaccessible fatty acids, Selenium and Iodine**

OP28

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Abstract

Western diets are often deficient in healthy n-3 polyunsaturated fatty acids (n-3 PUFA), including docosahexaenoic acid (DHA), and other nutrients that may protect against cognitive ageing and other diseases. To address this issue, a functional food based on a hamburger concept was developed using chub mackerel (Scomber colias) and seaweed (Saccorhiza polyschides), rich in DHA (and Se) and I, respectively. Design The proximate composition, lipid fraction (including FA profile), and Se and I content of the raw materials and the hamburger were analysed. The effects of culinary treatment (steaming, roasting, and grilling versus raw) and human digestion on nutrient bioaccessibility were evaluated to assess the hamburger's potential health benefits. Results and discussion The results showed that while the absolute values of the FA changed, their percentage values did not. The hamburgers had high levels of n-3 PUFA in the range 42.0-46.4 % and low levels of n-6 PUFA (6.6-6.9 %), resulting in high n-3/n-6 ratios (>6). Bioaccessibility tests revealed that the hamburgers could provide the daily requirements of eicosapentaenoic acid (EPA) + DHA with 19.6 g raw, 18.6 g steamed, 18.9 g roasted or 15.1 g grilled hamburger. The hamburgers also contained high levels of Se and I at 48-61 µg/100 g ww and 221-255 µg/100 g ww, respectively. Se and I bioaccessibility levels were 70-85 % and 57-70 %, respectively. Based on bioaccessibility, to meet daily Se requirements, 184.2 g raw, 170.7 g steamed, 152.2 g roasted or 162.8 g grilled hamburger would be necessary, while 118.1 g raw, 98.0 g steamed, 92.0 g roasted or 98.0 g grilled hamburger would be needed to meet daily I needs. Conclusion This functional hamburger could be a suitable source of EPA, DHA, Se, and I in the human diet, thereby providing biologically active nutrients for the prevention of cognitive ageing.

SESSION 2	Algiecel, biosolutions for decarbonization

OP29

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Abstract

ALGIECEL was founded to take part in solving the challenge of converting the CO2 emissions of today´s production methods into feasible business opportunities. The Company uses natural micro-algae organisms, a highly compact and high-yield photobioreactor technology fitted into standard shipping containers and a new revenue sharing business model to offer carbon capture as-a-service to industrial clients. The resulting biomass has a negative environmental impact, is rich in protein and omega 3 fatty acids making for optimal use as fish meal replacement. The Organization ALGIECEL was founded by Henrik Busch-Larsen, who also co-founded and scaled Unibio, a leading sustainable protein company. The team holds experience from notable companies such as Maersk, Falck, Nestlé, COWI, Chr. Hansen and BioPorto among others. The company collaborates with skilled partners such as RobLight, AN Group and the Danish Technological Institute (TI) RESULTS Algiecel is at the moment working with our pilot facility located in Taastrup Denmark, and we expect to start our full-scale unit in Q4 2024. We are excited to present the analytical results of our product intended for fish feed producers, which has a protein content of 58%. We are doing a full LCA analysis of our process to ensure minimal environmental impact, and thanks to our unique business model we expects to keep prices which are competitive with the fishmeal price. DISCUSSION Algae have been shown to greatly benefit the health and growth of juvenile fish. The Algiecel product will furthermore be significantly more sustainable than fishmeal but also more sustainable than today's most popular algae in fish feed, the heterotrophic Schizochytrium sp. CONCLUSION Algeicel looks forward to sharing our results and tell more about the application microalgae for fishmeal.

SESSION 3	Production of savoury ingredient, an upcycling route for cod backbone

OP30

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Abstract

The aim of this study was to produce savory ingredients from cod solid side-streams using enzyme hydrolysis. The savoury flavour of foods is often enhanced by ingredients rich in glutamate (e.g. monosodium glutamate) or free glutamic acid (GLU), which provides the umami flavour. Free GLU can also be generated through hydrolysis of proteins. The production of savoury ingredients is thus a possible upcycling route for protein rich sidestreams. The savoury ingredient was produced from cod backbone by enzymatic hydrolysis using a mix of enzymes. After hydrolysis, the samples were centrifuged and the supernatant (savoury ingredient) was freeze dried and the precipitate, i.e., side-stream generated from the hydrolysis process, was dried. The quality of the produced savoury ingredient was evaluated by content of free GLU and sensory profiling and compared to a control (hydrolyzed backbone without enzyme treatment). The dried precipitate contains bones and proteins. The content of protein and selected minerals (P, Ca, K and Mg) was evaluated. In addition, their bioaccessibility was measured to evaluate the potential of the mineral / protein powder as dietary supplements. The enzyme hydrolysis resulted in a savoury ingredient high in free GLU. Moreover, the yield and content of free GLU was much higher than for the control. Results from the sensory analysis showed that 10-fold higher amount of backbone is needed for the control to produce the same amount of free GLU and approximately same umami intensity as for the enzyme hydrolyzed sample. In addition, the generated side-stream contained minerals which to some extent are bioaccessible and the bioaccessibility was higher for the enzyme hydrolyzed sample than for the control produced without enzymes.

SESSION 3	Valorization of Spanish rainbow trout (*Oncorhynchus mykiss*) muscle to obtain restructured products

OP31

Name: Helena M. Moreno Conde **Organization:** University Complutense of Madrid

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Abstract

According to the Food and Agriculture Organization of the United Nations (FAO), the total worldwide fish production is around 180 million tons; Europe produces the 10% and Spain is the highest producer in volume. Around 19,000 tons of rainbow trout (Oncorhynchus mykiss) are produced in Spain from aquaculture (5.5% of the total aquaculture production). This species´ meat has remarkable nutritional properties: rich in proteins, omega-3 fatty acids and significant amounts of vitamins and minerals. All the same, trout consumption in Spain is very low. However, the main operators in the trout market worldwide are interested on developing their trout products introducing new and added value trout products healthy and rich in proteins. The main objective of this work is the valorization of rainbow trout production surplus and the remaining cuts from its commercialization in fillets, to obtain new and attractive products to contribute to the diversification of the trout market and to get closer to the tastes and consumers demands. Trout muscle portions were minced or transformed into dough to obtain a myofibrillar protein concentrate to be used to get restructured products by hot and cold restructuring techniques (microbial transglutaminase, fibrinogen-thrombin, and fibrinogen-enriched dehydrated blood plasma). Several prototypes were made from different size of fish muscle portions, fish mince and myofibrillar protein isolates. In the resulting prototypes, texture, sensory properties and stability to different thermal treatments (immersion in hot water, steam, baking, frying and ironing) and conservation such as freezing, salting and lyophilisation) were analysed. These results allowed establishing the making process of different restructured analogues prototypes, boneless and with minimal fish flavour. These products would be of interest to promote trout consumption, offering a wide range of marketing possibilities being very suitable for children, the elderly people and people with swallowing problems.

SESSION 3	Personalizing the texture of seafood products via food 3D printing technology

OP32

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Abstract

The muscle structure will completely disintegrate when using the pH-shift technology for valorization of seafood side streams. Therefore, the recovered proteins lack the typical fibrous structure and anisotropic texture seen in whole cut seafood products, e.g., fillets. 3D food printing allows layer by layer production of food from a predesigned simple to complicated digital model. This provides flexibility in modifying food production by changing the digital design and/or the used materials to make food products more customized and personalized based on individual wishes and needs, not only in shape but also in texture. In addition, the unique anisotropic structure provided by muscle fibers plays an important role in the sensorial perception of animal muscle-based products; therefore, its mimicking is often desired. We have explored the unique opportunity that digital design in 3D printing technology provides to engineer textural properties of pH-shift produced protein isolates recovered from herring processing side streams in absence or presence of antioxidant-rich berry side streams. The effect of infill level, printing pathways and their combination in tuning and customizing textural properties of seafood products as well as in creating unique texture profiles in different parts of a 3D products will be presented. Promising results achieved for developing anisotropic microstructure via proper design and alignment of mesoscale fibers will also be presented.

SESSION 3	Bioactive compounds from fish by-product: a feasibility study for the development of innovative foods

OP33

Name: Adrián Honrado Frías **Organization:** Universidad de Zaragoza-CITA

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Abstract

Fish processing generates many by-products that still have interesting nutritional properties: polyunsaturated fatty acids and bioactive peptides, both with high biological activity. For these reasons, by-products could be used for human consumption, promoting circular economy. In this sense, the inclusion of these by-products in cerealbased products, which are normally high in carbohydrates and saturated fats, but low in protein, could improve their nutritional profile. Therefore, the main objective of this study was to develop MDDM (mechanically deboned and dried meat) and FPH (fish protein hydrolysates) from seabass, seabream and tuna and to study the feasibility of using them as an ingredient in biscuits production, to achieve a nutritional enrichment maintaining adequate sensory quality. For that, MDDM and FPH were incorporated into biscuit dough at 2,5 and 5%. MDDMs were subjected to a defatting and subsequent drying process. FPH were obtained by enzymatic hydrolysis with Alcalase® and, after centrifugation, the liquid phase was atomised. MDDM and FPH were characterised: TBARS, pH, colour and fatty acid profile. In biscuits, quality parameters were determined, and sensory analyses were carried out to establish the effect of MDDM and FPH addition. Results showed moderate oxidation (TBARS) which translated into the reduction of EPA and DHA contents. However, the levels found could be enough to reach nutritional declarations. Regarding biscuits developed, it was found that biscuits with an addition of 2.5 % and 5 % sea bass MDDM and biscuits with 2.5 % tuna FPH had a similar sensory quality as control although fish flavours/smells were detected. In conclusion, it was possible to enrich this type of biscuit with MDDM and FPH, obtaining products with higher nutritional quality. However, more research is needed to achieve optimal sensory quality.

SESSION 3	Does the consumer have any barriers and/or motives for new ingredients produced from seafood side-streams?

OP34

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Abstract

The aim of this study, which was performed within the BBI JU-funded WASEABI project (waseabi.eu), was to investigate consumer barriers and motives for products with ingredients from seafood side-stream. An on-line questionnaire consisting of 25 questions with subquestions in five language was open for consumers over a 6-month period. In total 469 consumers answered the full questionnaire. Based on the consumer answers and with focus on the main barriers and motives, it can be concluded that the most important for the consumers are the eating quality and that they want to be informed about the origin of the ingredients and raw material. Thus, by developing technologies that can ensure that foods containing ingredients from seafood side-streams are of high eating quality and by providing the requested information the most relevant barriers can be overcome, and consumers will be motivated to buy such products. Furthermore, a clean label is a motive for the consumer to buy the product. Likewise, the consumers also want to know about the environmental impact of the production of the food product.

SESSION 3	Can high quality gelatine be obtained from preserved whitefish skins?

OP35

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Abstract

Skin from white fish is highly desirable raw material as collagen and gelatine marked, especially based on marine raw materials, is exploding during recent years. This leads for the situation where collagen/gelatine producing industry facing the situation with the lack of collagen rich raw materials as fish skins and bones. White fish industry is one of the suppliers of the fish skin, however significant part of skin generated on board is wasted and dumped in the seas. One of the reasons is the lack of simple and suitable preservation technology, which would allow to bring to shore processing industry high quality raw materials for collage/gelatine extraction. In addition to traditional freezing technologies preservation with salt or/and acid could be applied as several gelatine extraction technologies has salt and acid pre-treatment steps in the extraction technology. The main objective of this works was to test and evaluate how these preservation methods influence the yield and quality of the extracted collagen/gelatine. Several skin conservation technologies such as freezing, salting and preservation by low pH were used followed by two different gelatine extraction technologies. All three tested preservation methods gave high yield of gelatine (8-13g gelatine/100g raw material) containing desirable amino acids composition with imino acids (proline and hydroxyproline) concentration up till 19% of all amino acids. This work indicates that simple and cheap preservation technologies can be used for storage and transportation of whitefish skins, which then canl be used for production of high-quality marine gelatine.

SESSION 3	Extraction of Gelatine and other compounds of interest from Lumpfish

OP36

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Abstract

Lumpfish is a specie where female adults are targeted for their roes and where juveniles are used in aquaculture salmon tanks to eat lices. However, those fish once they have served their purposes are often discarded or used only for low value products. As the skin of the lumpfish represent close to 25% of its weight, gelatine extraction for higher end valorisation is of interest. Numerous tests comparing different gelatine extraction methods from the lumpfish skin were tested with the add of extra steps to reach the purest gelatine with the highest yield and quality. Basic, acid and different enzymatic extractions (pepsin, papain and bromelain) methods were tried as well as adding H2O2 to improve the colour. Once the proper method had been developed for the skin of the adult lumpfish, tests were made on the whole juveniles comparing pre-processing (mixed, cut or full) to extract both gelatine and protein from the pieces. Analysis of yield, colours, bloom strength and protein composition were made. The best gelatine extraction method, with yield of 6% (wet weight) and 44% (dry weight) from skin were obtained when pepsin was used. The type I gelatine jellified through the standard bloom strength protocol and were white. The juvenile lumpfish were tried for a combined extraction of proteins and gelatine from their whole bodies and the mixed and cut fish gave the best results. The gelatine was white and wet yields of 2% were obtained. Further tests would be needed to be conducted to implement this extraction on a bigger scale but it opens new doors for this specie to be valorised better in the future both for adults and juveniles.

SESSION 3	Utilization of Atlantic lumpfish (*Cyclopterus lumpus*) skin as a source for gelatine extraction

OP37

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Abstract

The aim was to valorise underutilised lumpfish skin to extract gelatine and evaluate the effect of extraction parameters on the yield and biochemical and physical characteristics. Material/methods/design: Frozen post roe extraction lumpfish carcass received from Royal Greenland AS and Biopol/University of Akureyri were used for the study. The skin pieces were initially deproteinized (0.1N NaOH) and demineralised (0.1N HCl). The pre-treated skin samples were divided into 27 experimental units for extraction based on acid to skin ratio, reaction temperature and reaction time and further freeze dried to isolate the gelatine. Yield, proximate composition (ash, dry matter, lipid and protein content), amino acid composition and hydroxyproline content of the different fractions of the lumpfish carcass were determined to assess the raw material. For the extracted gelatine the yield, dry matter, protein, total amino acid, hydroxyproline, molecular weight distribution by SDS PAGE and rheological properties by Oscillatory rheology evaluation was determined. Results and discussion The proximate and amino acid profiling of the lumpfish skin indicated a high protein and glycine content (30% of the total amino acids). A maximum gelatine yield of 40% on dry weight basis was reported with the gelatine having a hydroxyproline content of 7.2%. The SDS PAGE analysis confirmed the presence of gelatine peptides with high molecular weight (>100 kDa). The rheological properties indicated a lower gelling and melting temperature, storage modulus and viscosity for lumpfish gelatine compared to conventional terrestrial gelatine but comparable to cold water fish gelatine. Conclusion The study successfully demonstrated that the otherwise underutilised lumpfish carcass could be used as a raw material for extraction of fish gelatine using acid hydrolysis resulting in value addition of lumpfish side streams generated after roe harvesting.

SESSION 3	Lipid oxidation during ensilaging of salmon by-products and effect of pH and antioxidants

OP38

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Abstract

Ensilaging is both a preservation and processing method used to process fish by-products into ingredients like lipids and proteins. Obtained ingredients by ensilaging can be used for feed and other applications. The process is simple, grinded by-products are mixed with acid to keep pH below pH 4 to prevent microbial growth. Endogenous enzymes present in byproducts autolyze the raw material depending on pH, temperature, and time. The aim of this work was to study how a pH below 4 influences the quality of lipids and proteins during storage of silage of salmon viscera and if added antioxidant can influence quality changes. Salmon viscera was mixed with commercial formic acid mixtures with no antioxidant and with antioxidant (mixture of propyl gallate and butylated hydroxyanisole). Different amounts of formic acid were added to get the pHs: 3, 3.5 and 4. The silage was stored for 4, 11, 18 and 25 days. The changes in lipids (both hydrolytic and oxidative) were analyzed both by high field NMR and traditional oil quality methods: free fatty acids, peroxide value and p-anisidine values. The protein changes were analysed by high field NMR. Proteolytic and lipolytic activity in silage were also analysed. The results showed that free fatty acids formation increased with increased silage pH. Lipid oxidation increased with storage time. In the beginning of ensilaging, lower oxidation product amount was obtained in lipids from ensilaging with antioxidants. Moreover, a lower amount of oxidation products was also obtained at pH 3. However, oxidation developed during storage and after the 11th day of storage there was no effect of pH or antioxidant on the amount of oxidation products in the oil. The proteases were active at pH 3-4 and a clear pH effect was not obtained. The dry matter content increased in the water-soluble protein phase. The content of small peptides in the silage also increased during storage with no clear effect of pH.

SESSION 3	Valorization of solid seafood side-streams. Life cycle assessment of an enzymatic hydrolysis technology to recover flavoring agents from salmon backbones

OP39

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Abstract

In recent years, there has been a substantial increase in world fisheries production, with current estimates pointing to a total of approximately 200 MT per year. However, this increase in production has given rise to a major problem regarding the large amount of liquid and solid waste produced by the fishing industry. Studies show that between 20% - 80% of the weight of landed fish can become waste, depending on the processing methods and species caught. Disposal of this waste has become a major environmental problem, as it can lead to pollution and other negative effects on ecosystems. Efforts are currently being made to solve this issue, such as using fish waste as fertilizer or converting it into fish meal and oil. However, more comprehensive and sustainable solutions are needed to manage this growing issue. The present work has focused on the evaluation of the environmental performance of an innovative enzymatic hydrolysis technology for the valorization of salmon backbones to obtain flavoring agents. The life cycle assessment methodology was used to identify the burdens of this technology on the carbon footprint (CF) and freshwater eutrophication (FEW) indicators. The functional unit selected was 1 kg of flavory agents produced (95% d.m.). The life cycle inventories were obtained from a real pilot plant installed in Spain. The proposed technology, which in addition to the main product also obtains fish oil and minerals as by-products, showed a production of 0.11 kg of flavoring agents/kg of salmon backbones. In terms of environmental loads, the technology was mainly affected by electricity consumption (more than 65%) for both impact indicators analyzed; the use of enzymes was also significant for the FEW indicator, representing around 20%. Likewise, this technology presented a positive credit for the fish oil and minerals produced as by-products. In the case of fish oil, it can directly substitute the production of vegetable sources, such as soybean oil. In summary, the analyzed technology presents a CF of 1.22 kgCO2e/FU and a FEW 2.18E-04 kgPe/FU, which are in a range of current valorization route, such as fishmeal and oil; however, with this innovative technology the final extraction ingredients can reach a high valorization level and can also be applied to food products.

SESSION 3	**Influence of high-pressure processing in the chemical composition and yield of fractions from a mixture of rainbow trout (*Oncorhynchus mykiss*) and Atlantic salmon (*Salmo salar*) rest raw material after enzymatic hydrolysis**

OP40

Name: Elissavet Kotsoni **Organization:** NTNU

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Abstract

The fish by-products generated from the fish processing industry may be a useful resource for bioactive compounds when non-thermal novel technologies are applied for their utilization. High-pressure processing (HPP) has been long used for the preservation and extension of the shelf life of seafood and constitutes a promising technology for the increased recovery of valuable compounds, such as lipids and proteins. The aim of the current study was to evaluate the chemical composition and yield of the fractions obtained after enzymatic hydrolysis on a mixture of salmon and rainbow trout rest raw material pre-treated by high-pressure at 200MPa, 400MPa, and 600MPa for 4 and 8 minutes. A minced mixture of fresh Atlantic salmon (Salmo salar) and rainbow trout (Oncorhynchus mykiss) by-products consisting of trimmings, heads, skin, bones, and tales, in proportion 1:1 w/w, was subjected to high-pressure pre-treatment. Six different pre-treatments were applied; 200MPa x 4 min., 200MPa x 8 min., 400MPa x 4 min., 400MPa x 8 min., 600MPa x 4 min., 600MPa x 8 min. Then, the samples were hydrolysed enzymatically, and five fractions were collected; paste/solids, oil, emulsion, fish protein hydrolysates (FPH), and sludge, which were further analysed. All the fractions were analysed for protein, ash, moisture, and oil content. In addition, the free amino acid composition and degree of hydrolysis were determined in FPH. The pre-treated samples were compared to an untreated sample. Changes in the protein and oil content (g/100g dry weight) were observed in some of the fractions from the pre-treated samples compared to the control, as well as a lower amount of free amino acids in the FPH of pre-treated samples. The best results were given when the pressure was higher.

SESSION 3	Baltic herring hydrolysates: their effects on an in vivo mouse model of obesity

OP41

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Abstract

Type 2 diabetes and associated cardiovascular and older age memory diseases are growing worldwide along with Western lifestyles and obesity. Fish fats, particularly omega-3 fatty acids, have been recognized as healthy. Recently, evidence on beneficial health effects of fish peptides is also growing. We investigated the effects of peptide fractions digested from Baltic herring on markers of blood glucose regulation, diabetes and silent inflammation in a high-fat high-sucrose diet mouse model. The mice were given the peptide fraction for 16 weeks either 0, 0.6 or 1.8 mg/mL in drinking water or sitagiblin (0.1 mg/mL) as positive control group. The peptide fraction normalized dose dependently the markers of glucose metabolism and inflammation the 1.8 mg/mL being essentially as effective as sitagiblin. The HOMA-IR score (Homeostatic Model Assessment-Insulin Resistance) improved from 17 in control to 6 -6.5 in mice drinking 1.6 mg/mL of peptide fraction or sitagiblin ($p<0.001$).Our work aims to produce new high value-added products from undervalued fish, to improve the profitability of fisheries, to promote circular economy and to contribute to public health. These results suggest that peptide fractions from Baltic herring proteins may have beneficial effects on type 2 diabetes, its precursor and silent inflammation thus having great potential as a health-promoting food or dietary supplement.

SESSION 3	Antidiabetic properties of mackerel by-product hydrolysates

OP42

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Abstract

The objective of this work was to study the in vitro antidiabetic properties of mackerel by-product hydrolysates. For this purpose, fish by-products, including heads, bones, thorns, skin, fins, and viscera, were hydrolysed by using different enzymes (papain, pepsin, and Protamex®). The freeze-dried hydrolysates were characterised by analysing the content of total soluble proteins, TCA-soluble peptides, and free amino groups. In addition, the antidiabetic activity of the hydrolysates was determined by the α-amylase and α-glucosidase inhibition assays. Hydrolysis degree of samples processed by using papain and Protamex® was higher than pepsin hydrolysates. In this sense, pepsin hydrolysates exhibited the lowest content in soluble peptides and the highest soluble protein content. All the hydrolysates had strong inhibitory effects on both α-amylase and α-glucosidase activity at 100 mg/mL. Moreover, all the samples showed αglucosidase activity at 50 mg/mL concentration. Pepsin was more effective than papain and Protamex to obtain fish by-product hydrolysates with high antidiabetic properties. These results highlight the importance of the enzyme selection to obtain fish hydrolysates with high antidiabetic activity. Mackerel by-products could be considered a potential source of high-quality dietary protein and health enhancing peptides.

SESSION 3	Pectin/marine-chitosan hydrogel with improved properties for the delivery of phenolic compounds from strawberries

OP43

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Abstract

Food processing industries generate huge amounts of by-products, and a great effort has been done to exploit and valorize it as a source of valuable compounds. Chitosan and pectin are two important polymers found in crustacean shells and citrus processing by-products, respectively. These can be used as gelling agents for developing physical hydrogels. Several pectin-chitosan hydrogel formulations have been suggested as bioactive delivery systems. However, the molecular weight (Mw) of chitosan differs per study, and the reason for using low, medium or high Mw chitosan in these systems is not clear. In the current research study, pectin-chitosan gels were developed to deliver phenolic compounds from strawberries. The effect of the Mw of chitosan was investigated, and, to improve the stability and encapsulation efficiency of the gels, mixtures of low and high Mw chitosan were used during the gelation step. Materials/methods: Low-Mw chitosan from shrimp shells, high-Mw chitosan from crab shells, pectin from citrus peel, and aqueous strawberry extracts were the main materials for the development of the gels. The gelation of the tested systems was assessed by the inversion tube test, and for their characterization, the weight variations, encapsulation efficiency, FTIR and morphological analysis, and the release of phenolic compounds were investigated. Results/Discussion: A pectin-chitosan hydrogel containing a mixture of low- and high-Mw chitosan was found to have higher encapsulation efficiency of strawberry phenolic compounds, improved stability in phosphate-buffered saline under storage, and stable release of phenolic compounds under different pH's.

SESSION 3	**Synergic interaction between chitosan and peptides from shrimp side-streams (*Pandalus borealis*) before and after pulsed electric field treatment, a study focused on emulsifying property**

OP44

Name: Lucas Sales Queiroz **Organization:** DTU

Authors: Lucas Sales Queiroz[1,2]*, Driton Veliji[1], Emil Fogh Jesen[1], Federico Casanova[1], Flemming Jessen[1], Charlotte Jacobsen[2], Paul Kempen[3] and Nina Gringer[1]

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Abstract

Even though shrimp byproducts have shown interesting bioactive components, such as chitin, proteins/enzymes, pigments, and lipids, most of these byproducts are discarded. Herein we aimed to evaluate the interaction between chitosan and peptides from shrimp, before and after pulsed electric field treatment to further explore the emulsifying property. Material & Methods Protein hydrolysis was applied using Trypsin 0.5% (E/S). Chitosan was obtained with a 80% (FTIR method) degree of deacetylation using ultrasound during the synthesis; Supramolecular chitosan/peptides complexes were formed at two different pHs 6.2 and 4.2, and their emulsifying properties were evaluated. Samples were characterized by Differential Scanning calorimetry (DSC), Fast Protein Liquid Chromatography (FPLC) and Size Exclusion Chromatography Coupled to Multi-Angle light Scattering (SEC-MALS). The emulsion stability was verified by Turbiscan method (TSI value), and the interfacial properties and viscosity were studied by double wall ring rheology and bulk rheology, respectively. Confocal Laser Scanning macroscope (CLSM) and cryo-TEM microscopy techniques were applied. Results & Discussion Emulsion stability was significantly improved in the presence of chitosan/peptides, and even higher when PEF was applied. Microscopy techniques revealed a cluster formation when proteins and chitosan were used as emulsifier whereas in presence of chitosan no aggregates or clusters were evident. The formation of cluster entrapped the oil droplets and increased the viscosity. Interfacial rheology also revealed a faster solid/film formation on the oil/water interface and a higher value of storage modules when Chitosan/protein and PEF was used. Conclusion The study highlighted the potential functionalities of shrimp side-stream and the positive impact of pulsed electric filed in the valorization of these components when aimed to be applied as alternative emulsifiers.

SESSION 3	Interfacial and emulsifying properties of enzymatically derived peptides from shrimp head and shell

OP45

Name: Federico Casanova **Organization:** DTU

Authors: Federico Casanova[1], Narjes Badfar[2], Ali Jafarpour[2], Lucas Sales Queiroz[1,2], Flemming Jessen[1], Charlotte Jacobsen[2], and Nina Gringer[1]

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Abstract

In the industry, shrimp is usually processed for meat recovery, while the remaining head, shell, and tail portions are considered by-products. These by-products contain bioactive compounds including chitin, protein, lipid, carotenoid and minerals. Material and methods. The priority of this research study was to enhance the protein recovery from shrimp waste by replacing the most commonly used alkaline deproteinization process with a more sustainable enzymatic hydrolysis process. In continue, the colloidal properties of enzymatically derived peptides, like their ability to stabilize O/W emulsions and their interfacial properties by dilatational rheology technique, was investigated. Results and discussion. Emulsions stabilized with peptides obtained by alcalase (Alc) and trypsin (Tryp) treatment present an average diameter of 18 and 42 µm respectively, after 8 days storage. Interfacial tension, measured by static pendant drop, shown a constant value of 24 and 19 mN/m after 25 min. Furthermore, viscoelasticity, molecular and microstructural behavior of protein hydrolysate at the interfacial layer in the nonlinear regime was extrapolated by Lissajous plots. Conclusion. The possibility to employ enzymatically derived peptides from shrimp head and shell in industry applications is presented and discussed.

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SESSION 3	The seafood process water biorefinery -from waste to value

OP46

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Abstract

The conversion of whole fish and shellfish into consumer-ready seafood products is in many cases a highly water-intense operation. For example, industrial steaming and peeling of shrimps requires up to 50 m3 of water per ton peeled end-product. Besides providing high freshwater footprint, valuable nutrients are lost into the used process waters which are then subject for costly in-house pre-cleaning to release the waters into local sewage plants. Chemical flocculation with e.g., Fe/Al followed by flotation are today the most common methods, which prevents further use of the recovered sludge or outlets for food or feed purposes. In the past 10 years, several research projects comprising Chalmers have aimed at finding alternative routes to recover nutrients which are currently lost into seafood process waters. Main water streams addressed have been from shrimp and herring processing. Beyond thorough characterizations, two approaches for their valorization have been applied, independently or in combination. The first one comprises food-grade flocculation followed by dissolved air flotation (DAF) or centrifugation to recover a protein-enriched biomass. The second strategy involves the use of process waters as feed stock for cultivation of other organisms which can provide secondary protein. Using polysaccharides and salts as food grade flocculants/coagulants has allowed up to >90% of proteins to be recovered from process waters with DAF or centrifugation. The protein-enriched biomass has been successfully utilized in e.g., feeds for lobster larvae and salmon. When cultivating marine yeast, microalgae, and green seaweed with DAF-outlets or crude process waters, protein levels have in several cases been many-fold increased compared to organisms cultivated in control media. This reveals the possibility of creating double values from aqueous nutrient-rich side streams which, besides being lost from the food chain, also represents financial burden for seafood companies in terms of purification.

SESSION 3	Utilization of side streams from processing water in whitefish production

OP47

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Abstract

The aim of the study is to map the use of side stream resources from whitefish processing and run-of water for valorisation and waste reduction purposes. Different waterflow streams were evaluated, covering all the most relevant parts of the fisheries processing lines. Various physicochemical characteristics and properties of the side stream raw material from the water were analysed with that aim to valorise them as much as possible in a feasible way ensuring they are not washed out with the affluent water. The results of the study include quantification, analysis and evaluation of recoverable proteins from different processing streams. A discussion on possible utilisation methods for individual streams and results from preliminary valorisation trials using e.g. pH-shift and hydrolysis of the streams. Results from monitoring water use show that processing water use is very high in Iceland compared to Europe and the Nordic region. The chemical composition of recoverable byproducts from whitefish processing are overall good in quality and shows promise as raw material for valorisation processes. Some identified streams have the possibility of being utilized for food grade production, mainly fish mince for fish products or fish protein hydrolysates for pet food, or as specific food ingredients or nutraceuticals. The main challenges identified in the study include hygienic collection of materials and mechanical redesigning to capture and recover clean processing water. Opportunities include water and energy savings, cleaning the wastewater and valorisation potential.

SESSION 3	Production of savory compounds from mussel cooking water side stream

OP48

Name: Monica Gutierrez **Organization:** AZTI

Authors: Mónica Gutiérrez*, David San Martin, Jone Ibarruri, Carlos Bald and Bruno Iñarra

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Abstract

In a context of a constantly growing of world population, the need to adapt the food chain is a must. With this perspective, it is essential to reduce the environmental impact associated with the use of natural resources from food production. Special emphasis is placed on seafood because of the health benefits it provides for human nutrition. So that, the WASEABI project (waseabi.eu) arose to promote a better utilisation of aquatic resources, by testing different technologies that can guarantee an effective, sustainable supply system for seafood processing industries into to a biorefining scheme. This may enable those raw materials to be turned into commercial goods. This work has focused on the mussel processing. On average, it generates around 300-400 litres of wastewater per ton of cooked mussels, that in many cases are disposed into the sea without pre-treatment, contributing to the progressive deterioration of the marine ecosystem, or are treated as urban wastewater. This fact is especially relevant considering that the main pollutant in those effluents is the organic matter, mainly composed by useful proteins that can be used in food, feed or other valuable purposes. Therefore, this work shows the implementation of a solution for the recovery of valuable proteins from mussel cooking waters to use as fish-savoury ingredients. The interesting biomolecules retention and the high content on salt from the water contained in the mussels were the limiting factors. The proposed solution, membrane filtration, has been developed from the laboratory tests to the final implementation in the factory. The selected technology has been the nanofiltration to concentrate fish proteins and the diafiltration to reduce the salt content of the concentrates. This work shows the proof of concept that has been carried out in real conditions in Pescados Marcelino's with the adjustment and optimization of the selected technologies for obtaining protein concentrates.

OP49

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Abstract

In the Bay of Biscay (BoB), salmon by-products are currently collected and processed in a fishmeal and oil production plant. However, they could find much higher valuable options when processed into flavouring agents. In the framework of the BBI JU-funded project WASEABI (waseabi.eu), Salmon backbones resulting from the salmon filleting were hydrolysed using a combination of endo and exo-proteases to release the maximum of amino acids and a glutaminase to convert free glutamine into glutamic acid, responsible of the umami flavour. Different enzyme combinations and conditions were tested and a powder product with a 10% moisture, 80-85 %total protein, 1- 3 % total fat, 4 -7 % ash and 20 mg Free Glu/ g powder was obtained in the best conditions assayed. The process was reproduced at pilot scale in 50 kg backbones batches giving a yield of 9.0 % flavour powder with 84 % protein content, 2 % moisture, 2% total fat, 9% ash and a free glutamic content of 19 %. The process can be scaled up to produce a product with a significant free glutamic yield, opening the possibility for the valorisation of salmon backbones in higher valuable options as natural salmon flavours for food applications.

SESSION 3	Production of bioactive compounds from fish discards

OP50

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Abstract

Current European Common Fisheries Policy set up a discard ban that imposes their landing while prevent them from the direct human consumption. Fish discards are the main side-stream in fisheries and their valorisation must be promoted. The production of high value biomolecules from such raw materials arises as potential solution for their use. In this work, part of the BBI JU-funded project WASEABI (waseabi.eu), undersized Hakes were used as a model of fish discard of the Basque fleet in the Bay of Biscay to investigate the production of bioactive compounds. In a first screening, enzymatic hydrolysis was performed with five proteolytic enzymes that yields different peptides mixes and bioactivities. Antioxidant, antihypertensive and antibacterial activity were measured in each hydrolysate to select the most promising enzyme. None of the tested condition resulted in clear antimicrobial bioactivity, while all presented an interesting antioxidant and antihypertensive activity. Best enzyme was selected for a bioactivity driven optimization process to define the most favourable process parameters. Optimum parameters for maximising peptide yield or their bioactive activities felt withing different process conditions, so a combined output of activity and yield was modelled to maximise it and decide the best process parameters. Resulting conditions were scaled up to ensure the process reproducibility at larger scale and to better quantify yields, observing that laboratory modelled data allowed to predict expected pilot results. Obtained ingredient showed a bioactivity results similar to other crude hydrolysates reported in literature what indicates the technical feasibility of this valorisation options.

SESSION 1	Food for kings, use of lumpfish as feed for red king crab

OP51

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Abstract

In this project the aim was to increase meat content and value of small king crabs that would otherwise have been discarded, by feeding these juvenile king crabs with lumpfish. Red king crab is highly sought after because of its tasty meat and achieves the highest price per kg of all the seafood Norway exports. However, exports of king crab are limited to crabs of commercial size, i.e. crabs weighing more than ap. 1.5 kg. Small crabs weighing less than commercial size are mainly discarded. The Norwegian aquaculture industry uses millions of lumpfish each year to combat salmon lice. However, when the lumpfish becomes sexually mature, it stops eating lice and the fish are discarded or used for silage. Materials/methods: In the initial trial, 24 king crabs were kept in individual chambers to allow for monitoring of feed intake. The crabs were given four different feed diets comprised of: i) crab pellets, ii) lumpfish, iii) combination of lumpfish and crab pellets and, iv) crab pellets coated with lumpfish protein hydrolysate concentrate. Results/discussion: The preliminary results show that the king crabs preferred crab pellets coated with lumpfish protein concentrate. It also took a few weeks for the crabs to be appetizer and get to eating raw frozen lumpfish. However, halfway through the 12-week trial, the king crabs fed a combinatioon of crab pellet and lumpfish seemed to prefer lumpfish to crab pellets.

SESSION 4	Resilient future food systems: extending consumer knowledge along the fish value chain

OP52

Name: Cheryl Marie Cordeiro **Organization:** RISE Research Institutes of Sweden

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Abstract

This 2022 research focused on exploring the Swedish consumers' attitudes and perceptions of roach fish as food products. With an increasing need for sustainable food sources, understanding consumer attitudes towards lesser-consumed fish types like roach fish is crucial.
Method: A qualitative study was designed to gauge the consumer's opinions and attitudes about their usage of processed fish products. 124 consumers expressed interest, with 7 participants (3 men, 4 women, aged 40-71) finally participating in the focus group. The group tasted both prototype and commercial Finnish fish products.
Findings: Initial responses revealed a prevalent negative perception of roach fish, often described as "cat food" or discarded as unwanted. Most participants mistakenly identified all samples as mackerel. Historical attitudes towards roach fish, especially due to its small bones, deemed it undesirable. Interestingly, both older and younger participants viewed roach fish as negative, despite not having much direct experience with it. However, discussions highlighted potential opportunities, suggesting introducing roach in fine dining or delis with attractive packaging. There was also mention of introducing roach fish to children and young people in schools, aiming to reshape the narrative and overcome established biases.
Conclusion: The study underscores the deeply entrenched prejudices against roach fish among Swedish consumers. To integrate roach fish into future food systems resiliently, a multifaceted approach is needed, which includes changing the narrative through education, innovative product offerings, and targeted marketing strategies. It also shows the importance of consumer knowledge and empowerment along the fish value chain where greater knowledge of fish types can help make future sustainable food choices towards a more resilient food system.

OP53

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Abstract

Norwegian farmed salmon is an international success distributed over large parts of the world. The willingness to pay is so high that air freight is used to offer fresh salmon to some markets. However, air freight leads to large greenhouse gas emissions. Research shows that total emissions from the salmon value chain can be reduced by 50% if you replace airfreight of fresh salmon with boat transport of frozen salmon. However, from a marketing perspective, it can be challenging to replace fresh with frozen and thawed salmon. Freshness is one of the most important purchase criteria for seafood, and consumers perceived fresh seafood as healthier and of better quality than frozen. The overall aim of this study was to provide knowledge about how replacing fresh with defrosted salmon affects consumer acceptance. Data were collected through a survey among 500 consumers in Japan and the USA. The survey included open-ended questions, a questionnaire, and a conjoint study. The results show that US consumers had far more negative associations with thawed salmon compared with Japanese. The attitude to thawed salmon compared with fresh was also significantly more negative in the US, however, no difference in attitude towards thawed and fresh salmon was found in Japan. This shows that the associations consumers have with fresh and thawed salmon can be reflected in their attitudes. The willingness to pay for thawed salmon was 30% lower in both markets. The conjoint analysis showed that Japanese and. American consumers found fresh salmon more attractive than thawed. However, a segmentation analysis showed that there is a group of environmentally conscious consumers in both markets who wanted farmed salmon with a low carbon footprint. This segment seems very promising as a target group for thawed salmon.

SESSION 4	Consumers' perceptions of low-value cyprinid fish and products from them

OP54

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Abstract

The study aimed to determine consumers' attitudes and preferences regarding the purchase, preparation, and consumption of low-value cyprinid fish (such as small roach, small and medium freshwater bream and white bream) and products derived from these fish. Within the project "Reducing the negative impact of inland fisheries on the aquatic environment through innovative management of low-value fish species", qualitative consumer research in the form of focus group interviews was conducted in three different cities in Poland. The results of the studies showed that consumers have relatively little knowledge of low-value cyprinid fish and are unaware of their nutritional value or their production methods. Consumers often associate these fish with farmed fish, which they consider negative. Experiences with low-value cyprinid fish are usually reminiscences from childhood, and these fish are described as 'small', 'full of bones', 'cheap', but sometimes also 'tasty'. The condition of consumers' interest in niche products made from low-value cyprinid fish is the availability of boneless products on the market, along with the assurance that the product is made from locally caught fish and processed by a local producer. A barrier to the future processing of these fish is the uncertainty among consumers regarding processed products, and concerns about the composition and quality of the product, especially when is produced from fish minced meat. Another issue is the expectation that low-value fish products will be very cheap, which is not justified by processing costs. The research findings also demonstrate that the basis for future promotion of products from low-value cyprinid fish lies in educational initiatives related to origin, production methods and nutritional values.

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SESSION 4	IntER-Cold: interdisciplinary education and research platform in cold-chain of fish: from Norway to Japan

OP55

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Abstract

IntER-Cold aims to establish an education and research platform for knowledge exchange between researchers, students, and industry between Norwegian and Japanese institutes for the seafood cold chain. Moreover, the project aims to significantly impact: i) decreasing food waste, ii) improved utilization of rest-raw materials, iii) efficient chilling, freezing, and storage solutions, and iv) a long, high-quality shelf life of the salmon product. IntER-Cold is establishing various activities supporting knowledge exchange between the two countries. These activities are i) interdisciplinary seminars on cold chains, ii) guest lecturing, iii) workshops, iv) training programs, v) research-related visits and internships, vi) joint supervision of master diploma thesis, and vii) joint publications on research results. IntER-Cold is an interdisciplinary long-term education and research platform for Master students and young researchers focusing on cold chain development between Japan and Norway. Norway and Japan have a highly developed fish processing industry and a deep knowledge, practice, and technology in the cold chain. Japan has a high share of fish imports, while Norway is oriented toward fish export. The project has arranged digital and physical interdisciplinary seminars/workshops and contributed to guest lecturing, research-related visits and internships, and joint-supervision. At the WEFTA conference, we will present experiences from completed activities and discuss the project's impact on cold-chain development, knowledge transfer, and the importance of a successful collaboration between the two countries. Solving the complex challenges along the cold chain will affect both countries' economic and social sectors. However, this requires developed infrastructure, new interdisciplinary.

OP56

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Abstract

Mislabeling, either unintentional or deliberate, often occurs in many food categories, but also in seafood products. The reasons for that are various and depend on the species, the product types and the trade routes, which are often global and complex. Therefore, both the fishing industry and food control authorities have a great responsibility to ensure that only correctly labelled and safe fishery products reach consumers, as certain seafood products are associated, for example, with marine toxins such as ciguatoxins or species-specific allergens.European legislation has taken precautionary measures by requiring detailed labelling for seafood products to enable consumers to make their own choice. The following investigations highlight gaps in authentication of species of various taxonomy groups as fish, crustaceans and molluscs. Different solutions for seafood control are therefore presented to address these with newly developed specific methods as qPCR, NGS and microarray to support control laboratories. A new AI-based concept for the identification of potentially mislabelled seafood is introduced.

SESSION 5	Microplastics in seafood: study of different fish transformation process in the frame of contamination mitigation

OP57

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Abstract

Microplastics (MPs) have been detected in numerous fish species, yet the presence of MPs in filets or transformed seafood products has received only a limited attention in scientific research. Moreover, from these few studies, they only focused on end-products. The aim of this study was to gather comprehensive data from different processes and their steps, finally comparing them in order to estimate flow of MPs throughout process in order to provide recommendations. All samples collected during the different process were treated using the usual methodology: digestion with 10% KOH at 40°C for 24h, filtration on 90 mm GF/A 1.6 µm pore size filters, characterization of particles using stereomicroscope and FT-IR spectroscopy. Data have then were corrected regarding the contaminations that occurred during analyses in the laboratory. Using these corrected data, a comparative analysis was carried out for the whole processes to identify potential sources of contamination. The results varied depending on the specific process studied, making it impossible to establish a standardized pattern. Across processes, some steps help to reduce the quantity of some MPs. Regarding the sources of contamination, some were clearly identified for some processes, while for others it remains more difficult to characterize. The examination of various seafood product transformation processes provided a comprehensive understanding of the contamination levels of MPs throughout their different steps. This help to have a better knowledge of MP flows, and will contribute in elaborating some recommendation on good practices in order to mitigate the quantities of MP in seafood products.

SESSION 5	Microplastics quantification with mass-based methods in seafood products – exploring the potential for fast and reliable analysis

OP58

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Abstract

The presence of micro- and nanoplastic (MNP) particles was reported ubiquitously in all environmental compartments and its inhabitants with most studies focusing on the aquatic environment. Occurrence of MNP in the human body imply dietary intake as one viable uptake route and may raise concerns regarding food safety. Reliable data on MNP occurrence in food are still needed for risk assessment. Current methods for MNP analysis are often time consumptive and not yet validated, thus of limited suitability for food control purposes. In contrast to microspectroscopic methods (µ-FTIR, µ-Raman), mass-based methods like pyrolysis- and TED-GC/MS or quantitative NMR-spectroscopy might offer a fast and reliable approach for quantifying MNP independent from particle size. However, the extent of their limitations and possibilities remains to be explored. Therefore, the aim of this study was to evaluate the performance of several mass-based techniques for quantifying microplastics exemplarily in seafood matrix. A reference matrix of homogenised herring fillets spiked with plastic particles was prepared with enzymatic-alkaline digestion and method-specific post-filtration treatment. MNP analysis was carried out using pyrolysis-GC/MS, TED-GC/MS, DSC, and ^{1}H-NMR. Reproducibility, recovery rates, and sensitivity were determined, and limitations were tested exemplarily, including matrix and polymer specific effects. Preliminary results indicate a high sensitivity of pyrolysis-GC/MS, but with low reproducibility due to side reactions during pyrolysis resulting in high uncertainty values, which can be overcome by TED-GC/MS with higher sample intakes. In contrast, ^{1}H-NMR spectroscopy was highly reproducible but limited in its application with polymer solubility being a critical factor during sample preparation. In conclusion, mass-based methods have the potential for fast and reliable quantification of MNP in seafood products compared to vibrational methods like µ-FTIR or µ-Raman. Further research, e.g. on sample preparation is needed in order to establish a fully validated analytical procedure for the analysis of MNP in seafood products.

SESSION 5	Exploring multispectral imaging for nematode identification in fish fillets: towards automated detection

OP59

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Abstract

Nematodes pose a significant challenge for the fish processing industry, particularly in white fish. Manual labor is still relied upon for nematode detection and removal in fish processing lines. This study aims to address the initial steps of automatic nematode detection and differentiation from other common defects found in fish fillets, such as skin remnants and blood spots. To tackle this challenge, we used the VideometerLab 4, an advanced Multispectral Imaging System capable of capturing images at 19 different wavelengths ranging from 365 nm to 970 nm. Under controlled conditions, we acquired images of cod fillets using the VideometerLab. By leveraging this technology, we have the potential to identify nematodes and distinguish their spectral response from other unwanted residues. Furthermore, we incorporated normalized Canonical Discriminant Analysis (nCDA) as part of our efforts to distinguish between different components within fish fillets, representing a promising step towards the development of a prospective sequence segmentation method to detect nematodes. By incorporating multiple segmentation models and exploiting their collective strengths where individual models may capture certain characteristics within the fish fillet being segmented, the sequence segmentation has the potential of reducing false positives in the nematode detection process. The automation of nematode detection holds promise for enhancing process control in the fish processing industry, potentially leading to increased production rates and improved efficiency. By accurately classifying fillets with nematodes, operators could streamline the processing line, minimize manual labor, and enhance overall productivity.

SESSION 5	The influence of physical and geometrical changes on the insulation and strength of expanded polystyrene food packaging

OP60

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Abstract

Expanded polystyrene (EPS) boxes with a capacity of 3 kg are used to transport fresh fish in Iceland because of its good insulating and mechanical properties. The boxes should be strong enough to withstand the rigors of transportation and handling, thereby preventing damage to the seafood during transit and maximizing storage life of fresh seafood products. The primary aim of this project is to design lightweight EPS boxes that are sufficiently strong without compromising insulation. Given that the static stacking is the most common scenario in the shipping system, the impact of physical and geometrical modifications of the EPS box on the thermal and mechanical performance in this scenario are studied numerically. The modifications include changes in density, height, wall thickness, and radius of corners. A total of six parameters are analyzed. In the structural analysis, the critical force of the buckling on the long side wall is chosen as an indicator for the strength, and the ratio of percent modification to percent mass or strength change is defined as relative sensitivity. The results show that the change in density is the most sensitive to the weight and the strength of the box, whereas the modifications in the radius of corners are the least sensitive. In addition, all the modifications have an influence on the insulation property to a certain extent. To summarize, the modifications in the density, the height, and the thickness on the short side wall are encouraged, however, case is reversed for the radius on the outside corners and the thickness on the long side wall.

SESSION 5	High throughput screening method for *ANISAKIS* L3 detection of locomotor activity and viability under thermal-induced stress

OP61

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Abstract

A major challenge in the study of *Anisakis* larvae (L3) inactivation is the measurement of viability, since the current method relies on visual (i.e. sensory) observation, and also because large numbers of L3 need to be analyzed for the results to be statistically relevant. Viability as defined by EFSA is measured by monitoring the movement of the larvae spontaneously or after gently touching with tweezers and a needle; this is time consuming and very tiring for the assessors. On the other hand, the study of locomotor activity of the larvae can render insights of the changes occurring after certain stress levels. It would then be desirable to use High Throughput Screening (HTS) instrumental procedures for studying *Anisakis* inactivation. The objective was: a) to monitor instrumentally the locomotor activity of *Anisakis* L3 under stress conditions rendering 100% to 0% survival ratios and, b) design an instrumental procedure to establish viability that could substitute current visual inspection. More than 4000 *Anisakis* L3 enriched in *A. simplex s.s.* were subjected to different thermal treatments. Activity counts of individual L3 were measured in a HTS equipment (WMicroTracker MINI) under different acquisition conditions. After that, each larva was checked visually for viability. Results showed: a) progressive L3 recovery over time even up to 48 hour after thermal treatment, so that caution must be taken to assigning a larva as dead just with the observations of the first few hours; b) different *Anisakis* populations exist based on this recovery ability; c) by using decision tree analysis, a protocol was developed to discriminate (95% confidence level) between dead and alive larvae. These results open the possibility of HTS with high numbers of larvae, allowing the design of inactivation protocols in a fast and effective way, that will help improve the safety of fishery products.

SESSION 5	**Genotypic and phenotypic characterization and spoilage potential of Photobacterium strains isolated from European plaice (*Pleuronectes platessa*)**

OP62

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Abstract

Photobacterium is commonly reported as the primary specific spoilage organism (SSO) in cold-water marine fish species. Preventing its fast growth can extend the shelf-life and improve the microbial stability of fish products. Aiming to increase the knowledge on this SSO, *Photobacterium* isolates from spoiled fish were phenotypically and genotypically characterised. Moreover, inter- and intra-species variations in their spoilage potential were investigated to understand their metabolic activities better. Fifty-four *Photobacterium* strains have been included in this study. These strains were previously isolated from 14-day stored muscle tissue of plaice caught at different fishing seasons (September and April) and stored under different storage conditions (Whole fish on ice-0°C; vacuum packaged fillets-4°C and modified atmosphere packaged fillets-4°C (CO_2:O_2:N_2 = 70:10:20)). The genotypic identification of *Photobacterium* in species level was achieved using four housekeeping genes (16s rRNA, gyrB, gapA and recA). *Photobacterium* isolates were phenotypically characterised based on their NaCl-tolerance (0, 1, 3, 6%) and their ability to grow at different incubation temperatures (4, 8, 15, 20°C) and atmospheres (air, 100% CO_2). Their spoilage potential was assessed by investigating their ability to produce H_2S, trimethylamine, and degrade inosine-monophosphate into inosine and hypoxanthine.Photobacterium isolates were classified into *P. iliopiscarium* (53%), *P. phosphoreum* (41%) and *P. carnosum* (6%). The optimal growth conditions were either 15°C or 20°C combined with 1% NaCl. The presence of CO_2 significantly inhibited strains' growth. However, the higher the incubation temperature, the less the CO_2 inhibitory effect. Interestingly, all the isolates presented H_2S-activity. Moreover, significant differences between isolates were found in the TMA, inosine-monophosphate, inosine, and hypoxanthine concentrations produced, indicating inter and intra-species metabolic variations.The study identified optimal growth conditions, assessed spoilage indicators, and revealed inter- and intra-species variations, which potentially facilitate the development of targeted strategies for extending the shelf-life and enhancing the microbial stability of retail fish products.

SESSION 6	Live storage of European plaice – welfare and quality

OP63

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Abstract

Both catch and processing of plaice are limited in Norway, as is the profitability. Live storage of plaice can be an opportunity to obtain a profitable fishery. Larger quantities of plaice can then be stored in cages and slaughtered when needed to ensure stable deliverances to the markets.European plaice, *Pleuronectes platessa*, was caught off Lofoten islands (Norway) in September 2022 using demersal seine. The fish were kept alive in tanks onboard the vessel at 250 and 500 kg/m^2. After 2 days the fish were transferred to a sea cage for live storage. Sampling was performed after the catch and after 16 and 26 days of storage.Catch damages were recorded, and the development of the damages was followed during live storage. A scheme for evaluating the fish welfare was developed, and the welfare was evaluated during the live storage. After slaughter, the fish were stored on ice for 6, 9, or 13 days prior to filleting and sensory evaluation of fillets. Then, muscle samples were collected from the fillets to assess the content of water, protein, and free amino acids in the flesh. During live storage, catch damages like blood stains become less pronounced, while marks on the skin from the fishing gear become more visible. There are more damages on fins the longer the live storage. Also, there were significantly more fish with cataracts the longer the shelf life. The texture of the fillets became softer during ice storage, and the longer the live storage the softer the fillets. The water content increased significantly during live storage, while the levels of histidine, lysine, proline, and threonine decreased significantly.

SESSION 6	Large cod more susceptible to Injuries in seine fishing

OP64

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Abstract

Seine nets are considered relatively gentle if the catch is not too large. However, there is great variation in the size of cod caught with seine nets, which places great demands on both equipment and handling. A large cod weighing eight kilograms may need to be handled differently than a fish weighing two kilograms, in terms of welfare and quality. Over time, fishing companies have experienced challenges regarding the quality of the largest cod. This was the reason why two fishing companies joined forces with Nofima to document the loss of quality and see if good solutions could be found.The trials have taken place over two seasons, involving catches of different sizes, and from different vessels, which have handled the fish in slightly different ways. Trials involving towing speed and haul time and the effect of codend releasers have been carried out.The larger the fish, the worse the injuries that affect welfare and quality. A punctured swim bladder resulted in internal bleeding that gave discoloured loins. Smaller fish seem to tolerate this beter. In addition, large cod also suffer injuries when they are sent through tubes and pumps that are not dimensioned for that size of fish. In the project, the scientists have shown that pumping when using unfavourable tube diameters can break the spines of the largest fish.Large cod are generally of poorer quality than smaller cod, due to the events during the capture process. This is regardless of how the vessel is rigged. Cod that cannot be used as planned due to bleeding and other injuries, for example, salted cod or clipfish, represents a significant cost for the fishing companies.

SESSION 6	Technological, economic, and social aspects of an innovative shrimp de-shelling technique

OP65

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Abstract

Each year, several Mio tonnes of shrimps and prawns are caught and farmed worldwide. In this context, the Brown Shrimp (*Crangon crangon*) Capture Fishery in the Southern North Sea with an annual average catch of approximately 30.000 tonnes appears to be negligibly small. However, the fishery is and has often been a major driver of technical innovations in shrimp fisheries, e.g. regarding on-board catch processing, gear development and, since the beginnings, devices for automatic de-shelling. Here we will report the state of an ongoing project that develops and tests a machine prototype based on a novel de-shelling technology. Additionally, we investigate the organisational and social conditions under which this de-shelling machine may be deployed in an economically efficient way. Our preliminary data indicate that the new technology is functioning as expected, even across a relatively wide span of shrimp body sizes and forms. The results also imply that the contact-free de-shelling is delivering a few percent more of shrimp meat compared to other, mechanical techniques. These include existing machines and the widely practised de-shelling by hand after transporting highly preserved Brown Shrimps to low-wage countries. Another major focus of the project is the efficient utilisation of side streams emerging from an automatized, regional de-shelling operation. Although new, growth-stimulating functionalities of *C. crangon* remains for shrimp aquaculture feeds have recently been discovered, remains are so far predominantly discarded. We finally discuss how, with the help of the novel technique, the traditional, family-owned coastal Brown Shrimp fisheries may become more independent of the oligopsonic market structures. Currently, the value chain is dominated by very few international whole salers who centrally organise de-shelling and retail.

SESSION 6	Gentle peeling of cold-water prawns (*Pandalus borealis*)

OP66

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Abstract

Royal Greenland is the world's largest supplier of cold-water prawns (*Pandalus borealis*). Part of the prawns caught at sea are processed ashore, where they are quality-assessed before entering the production line, where they are matured, cooked, peeled and frozen as cooked and peeled (C&P) prawns, which is a ready to eat product.In this industrial PhD project, the maturation process of cold-water prawns is investigated to explore the options for introducing a shorter maturation time to optimize yields and prawn quality via gentle peeling. Currently, Royal Greenland is the largest freshwater consumer in Greenland, consequently minimizing this consumption and working with alternative water resources is of great interest [3]. In addition, the use of sea water to increase process sustainability is investigated. Consequently, increasing the product quality and sustainability of C&P prawn products. As prawns are a perishable product, decreasing the maturation time also minimizes the discard of prawns as material.As a first step the biochemistry and physiological processes of the natural molt stages in *P. borealis* are investigated to understand the mechanisms underlying the natural shell- loosening process in prawns. Next, the details of connections between the shell layers, epidermis, and the shrimp meat are examined in relation to the molting and practical peelability of the prawns. The goal is to develop shorter maturation and gentle peeling that are based on natural principles, and which are applicable in an industrial setting with predetermined conditions of NaCl concentration and temperature.Knowledge gained in this project will aid in the change towards a more sustainable processing of prawns, resulting in higher quality prawns for the world market.

SESSION 6	**The effect of subchilling and storage conditions of brown trout (*Salmo trutta*) on shelf life**

OP67

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Abstract

The purpose of the present study was to evaluate the effect of subchilling in refrigerated salt water (RSW) and storage conditions on quality and shelf life of whole gutted brown trout (Salmo trutta).Whole gutted brown trout were obtained from a local producer and transported to the laboratory. Fish were weighted, tagged, and immersed in RSW tanks (3,5% salinity and -1°C) for 24 hours. On day 2, fish were taken out and divided randomly in two groups, one to be stored on ice and group o without ice. Control group followed the production line and was transported to laboratory on day 2. Fish was further stored for 18 days and analysed for water holding capacity (WHC), colour, texture, microbiology, and enzyme analysis.The present study showed an increase in WHC in fish from both RSW groups than the control through the storage, while there was not significant difference in water content between groups. There was significantly higher skin lightness for groups that were in RSW with decreasing trend during the storage. Looking at the enzyme analysis it was observed increase in enzyme activity from day 0/2 to day four and with decreasing trend in all groups afterwards. Microbiological parameters showed no significant difference between ice and no ice stored fish. Textural results showed increase in hardness of all filets during the storage.The present study showed that fish could be stored without ice subsequent subchilling in RSW tanks.

SESSION 6	**Weight gain of Atlantic cod (*Gadus morhua* L.) during storage in refrigerated seawater (RSW) and drip loss during further storage on ice**

OP68

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Abstract

When trading and producing fish in Norway, discrepancies between the purchased quantity and the amount produced or received by the buyer have been reported. This weight loss is mostly registered when buying fish that has been stored in RSW on board the vessel. In this work, weight changes during storage in RSW followed by storage in tubs with ice are studied.Atlantic cod (Gadus morhua L.) was caught off the island Senja using gillnet in March 2023. On board the fishing vessel the fish was exsanguinated and stored in seawater (4 - 6°C) for 2 - 8 hours.Cod were stored in RSW in 1000 L tubs for 0,1,2,3 days and further on ice for 3,2,1,0 days, respectably. Weight changes during storage were recorded, and water content in different parts of the fish are analyzed in order to locate where the potential water uptake is greatest.The results showed that the water absorption, and thus the weight increase, happens most rapidly during the first 24 hours while stored in RSW. The weight increase continued during storage in RSW, and during the following ice storage, a corresponding weight loss was observed. When inspecting the fish, several pockets of water were observed, especially under the black lining. This water is possibly not drained before the purchase weight is recorded and may be a large part of the explanation for the discrepancies recorded.

SESSION 6	**Application of a portable multispectral imaging prototype for detection of spoilage in Atlantic salmon *(Salmo salar* L.) stored on ice**

OP69

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Abstract

The aim of the present study was to investigate the potential of a portable, easy-to-use, and cost-efficient multispectral imaging prototype (VideometerLite) to detect quality changes as a function of storage time for raw, farmed Head-On-Gutted (HOG) salmon stored on ice.Multispectral images of gills and three regions of the skin obtained by the VideometerLite prototype at seven wavelengths (405 nm, 460 nm, 525 nm, 590nm, 621 nm, 660 nm, 850 nm) were compared to the traditional Quality Index Method (QIM) and microbiological enumeration of Aerobic Plate Counts (APC), Psychrotrophic Plate Count (PC), H2S-producing bacteria, Pseudomonas and Lactic Acid Bacteria (LAB) in a storage trial for 17 days. The fish was assessed as fresh (QIM score< 5), mature (5<QIM score <15) or spoiled (QIM score>15) on days 1-6, 8-15 and after storage day 15, respectively. The microbial counts for all tested parameters, except lactic acid bacteria, increased steadily during storage and correlated with the increase in QIM score (r=0.941-0.974, p<0.001).Reflections of fresh skin were significantly higher (p<0.05) than spoiled skin for all wavelengths and skin regions tested, with one exception (skin region of neck at wavelength 850 nm). The decrease in reflection from skin of the belly and the tail during storage showed moderate negative correlation with the increase in QIM score for all wavelengths (r=-0.792--0.385, p<0.05), with the strongest correlation at 405 nm. Significant differences of gills reflections were only found at 850 nm, where spoiled gills showed higher reflectance than those analysed fresh and mature. It is concluded that the portable multispectral imaging prototype can distinguish between fresh, matured, and spoiled HOG salmon stored on ice by analysing the fish skin. Moreover, we are still working on data acquisition and updated results will be present at the conference.

SESSION 6	Industrial solution based on hyperspectral imaging for the determination of remaining shelf life in Atlantic cod

OP70

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Abstract

Previously, several models for determining remaining shelf-life for Atlantic cod fillets (Gadus morhua L) have been developed based on hyperspectral imaging. The aim of this research was to evaluate if those models were robust when applied to cod fillets at a fish processing plant under industrial conditions.The Atlantic cod were caught using different fishing gears and then stored in ice, for different timeframes, before being processed at the fish factory. In an industrial setting, as this, the exact remaining shelf-life is unknown, but presumably similar for all fillets within the same batch of fish. After filleting and skinning, the fillets were scanned using a hyperspectral camera (HySpex Baldur VNIR-1024, Norsk Elektro Optikk) mounted within the Maritech Eye (Maritech Systems AS).The initial models to be tested were developed in 2022 based on a limited number of fillets, with a RMSE of only ±1.1 days when evaluated with an independent test set. Using a larger amount of fillets for this test, it was assumed that each batch should follow a gaussian distribution with different mean value and standard deviation.In this trial we observed gaussian distributions with varying mean remaining shelf life as expected for the different batches. The variance of the fitted gaussians was not consistent between batches.The inconsistency related to the distribution's variance is likely related to the assumption that all fish within a batch have the same remaining shelf-life. New experiments are needed to further refine and validate the models for an accurate prediction of the actual remaining shelf- life.

SESSION 6	A machine learning approach for the estimation of freshness in Mediterranean seabream using a portable Multispectral Imaging (MSI) device

OP71

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Abstract

The expansion of the Aquaculture sector, the automation of many procedures and the perishability of seafood enhance the need for implementing rapid, real-time technologies for seafood quality assessment. This study aimed to investigate the efficiency of MSI analysis coupled with machine learning for the quality assessment of seabream. Aerobically or vacuum-packaged fillets (n=400) were obtained both from different selling points and directly from the Aquaculture site. They were subsequently stored under various temperature conditions for specific time intervals. Total Aerobic Counts (TAC) were determined while MSI analysis using the VideometerLite instrument (VIDEOMETER, Herlev, Denmark) was also conducted. The data derived from the experimental process were used for the training of predictive neural models, aiming to estimate the microbial counts at different temperatures, packaging conditions and fish parts. The neural networks implementing the prediction model were discovered through an automated architecture generation and validation process, aiming to specify the simplest architecture that achieves the optimal precision/generalization capacity/explainability balance. Root mean squared error (RMSE), coefficient of determination (R2) and the Least Mean Square Error Capacity (LMS Capacity) were used as metrics for the evaluation of models' performance and generalization capacity. Microbial populations ranged from 3.0 to 8.5 log CFU/g, covering a wide range of different microbiological quality levels. Thirty (30) models were produced for different experimental setings, with their accuracy reaching or exceeding 0.8, with some cases served by an architecture without a hidden layer. Based on the model performance metrics, the results indicated a good prediction performance, with relatively low RMSE values (<0.60) and R2 higher than 0.80 in most of the developed models. The VideometerLite instrument could be used for the quality evaluation of seabream enabling industry to make fast, real-time and reliable decisions.

SESSION 6	Aging promotion of greater amberjack (*Seriola dumerili*) meat by using liquid Shio-koji

OP72

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Abstract

Long-term cold-aged fish, produced under refrigerated conditions for more than two weeks, has attracted attention owing to its rich umami taste from free amino acids generated by proteolysis. However, the shortening of the aging period is required because of several challenges during cold aging, such as food hygiene concerns, refrigeration costs, and space limitations. Liquid Shio-koji, a fermented Japanese seasoning made from rice and salt, exhibits high protease activity and considerably contains salt and sugar. Thus, effects of liquid Shio-koji on the aging promotion and quality of greater amberjack (Seriola dumerili) meat were investigated. The dorsal meat of greater amberjack was cut into cubes (1.5 cm3). The cubes (100 g) were marinated in 10 mL of liquid Shio-koji (13.0% NaCl, pH4.8) or heated-liquid Shio-koji at 4 °C for 48 h. Heated-liquid Shio-koji was prepared at 90 °C for 30 min to inactivate proteases. Marination in liquid Shio-koji resulted in increased TCA-soluble peptide and total free amino acid contents in the meat. Acceleration in protein degradation on the surface of the meat was observed in the SDS-PAGE pattern of the sample marinated in liquid Shio-koji. The salt contents of the samples marinated in liquid Shio-koji or heated-liquid Shio- koji for 1h were 1.2-1.3% and unchanged until 48 h. 1HT2 mapping obtained by nuclear magnetic resonance imaging showed that the region with shorter 1HT2 relaxation time shifted from the surface to the center of the marinated samples in a marinated time-dependent manner. The shift indicated an improvement in the water holding capacity (WHC) inside the meat, which was presumably influenced by the penetration of salt and sugar in liquid Shio- koji or heated-liquid Shio-koji. The use of liquid Shio-koji induces proteolysis of greater amberjack meat, leading to aging promotion and therefore contributes to sustainable seafood utilization and processing.

SESSION 6	Hyperspectral imaging to detect blood and melanin defects in salmon fillets

OP73

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Abstract

We aim to detect blood and melanin spots in Atlantic salmon fillets automatically using hyperspectral imaging and machine learning. An important quality parameter in the seafood industry relates to blood and melanin discolorations in fish fillets. Blood spots are caused by bruising during delousing, rough handling during slaughtering or inadequate bleeding post slaughtering. Melanin spots are caused by injuries and as a negative side-effect of necessary vaccination. Compared to whitefish, the detectability of discolorations in salmon fillets is complicated by the presence of red pigments like astaxanthin. Discolouration is undesirable for consumers, leading to downgrading in quality of these fillets. Early detection of these defects is important as it could facilitate sorting affected fillets for use in other products.The salmon fillets were scanned with a hyperspectral camera over the visible to near-infrared (493-946 nm) range. We applied a machine learning approach based on linear discriminate analysis (LDA), using a manually annotated subset of the data to build a blood and melanin detection model. Superpixel segmentation of the LDA-transformed images allowed us to leverage spatial data redundancy, reducing noise and increasing the robustness of the model.The simple structure of the LDA model facilitated training with a relatively small number of images and performed well with high precision and recall scores. Blood detectability is higher than melanin, due to characteristic spectra with distinct absorbance peaks of the former and a relatively flat absorbance spectrum of the latter. Effective pre-processing to normalise for extraneous variables affecting image acquisition, such as greasy contamination on the inspection window in the optical path, is important to maximise model performance in a real-world production line setting.The detection of blood and melanin defects by inline hyperspectral scanning has the potential to reduce waste and increase profitability during salmon fillet production.

SESSION 6	Texture characterization of Atlantic salmon using non-invasive imaging technologies

OP74

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Abstract

An important characteristic of consumers' quality perception of seafood products is the texture. Some instruments allow objective texture measurements, but those methods are destructive. We propose the use of hyperspectral imaging and diffusion tensor imaging (DTI) magnetic resonance imaging (MRI) for the non-invasive texture characterization of Atlantic salmon (*Salmo salar* L.).The proposed experimental design consisted of two different sessions. In the first session, one day *post mortem*, the salmon was slaughtered and filleted, and hyperspectral imaging was acquired from all the fillets. Then, the right fillet of each fish (n=49) was used for texture measurements on the filleting day, using a TA.HDplus Texture Analyser (Stable Micro Systems Ltd.). The left fillets were stored on ice for up to eight days *post mortem* (second session), and hyperspectral imaging and texture analysis were performed. The texture measurements were carried out on three loin areas of each fillet, starting from the Norwegian quality cut (NQC) towards the neck. Three texture reference methods were used: the compression test, the texture profile analysis, and the tensile strength method. In both sessions, loin areas from several fillets were selected for DTI. The hyperspectral images were acquired using the Maritech Eye (Maritech), an industrial-grade hyperspectral system in the range from 482-968 nm.Partial least-squares (PLS) regression was used to estimate texture parameters from the hyperspectral images. The results show a promising estimation of the texture parameters based on the spectral data, especially for the compression test measurements. The analysis of DTI data also shows some correlation with some texture parameters.Hyperspectral imaging and DTI are shown as potential technologies for the non-invasively characterization of texture in Atlantic salmon. Future works will include more sophisticated predictive models by using both the spatial and the spectral information from the hyperspectral data.

SESSION 6	**Optimization of extraction of round goby (*Neogobius melanostomus*) oil using supercritical carbon dioxide**

OP75

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Abstract

The round goby *Neogobius melanostomus*, originating from the Black, Caspian, and Azov Seas, is one of the most widely distributed non-native fishes in both fresh and brackish waters in the Northern Hemisphere. It is considered an invasive species with several documents of negative effects occurring in the wake of its invasion, e.g., reduction or even elimination of benthic prey species such as mussels and shrimps, and reduction abundance of commercially important fish species through competition for food and territory. However, previous studies on the proximate composition of round goby showed that it has a slightly higher lipid content than cod fillet with a relatively higher proportion of health beneficial omega-3 fatty acids, DHA and EPA compared to valued species such as rainbow trout and herring. Extracting oil from round goby not only diversifies the source of healthy lipids but also contributes to maintaining a sustainable marine ecosystem. Therefore, the aim of this study was to extract oil from round goby using supercritical carbon dioxide and ethanol as cosolvent and characterize the extracted oil. The effect of different extraction parameters (temperature 40-50°C, pressure, 250-350 bar, ethanol flow rate 1-3 mL/min) on the extraction yield, fatty acid composition peroxide value, and free fatty acid content of the oil was evaluated. Response surface methodology was used to identify the optimum extraction condition and interaction among the different parameters.

SESSION 6	Show me the Hemoglobin! A route to better understand the rapid lipid oxidation in Herring (*Clupea harengus*)

OP76

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Abstract

Today, large parts of the global catch of herring (*Clupea harengus*) are used for feed production rather than food. This is partly because of fast post-mortem lipid oxidation which causes undesirable sensorial properties. It is known that hemoglobin plays a significant role in lipid oxidation in fish muscle tissue, but the herring hemoglobin is poorly characterized which limits strategies to decrease the rate of hemoglobin mediated lipid oxidation. Our aim is to characterize individual herring hemoglobin isoforms in the context of structure, pH dependent autooxidation and lipid oxidation in fish model matrices. Live herring was bled (Ghirmai et al., 2020) and the hemolysate was recovered (Wu et al., 2017). Hemoglobin isoforms were then separated with an Äktapurifier 10 (Sweden) FPLC system based on differential isoform charge distribution with ion exchange chromatography with both a pH gradient (Binotti et al., 1971) and a salt gradient (Aranda et al., 2009). Protein fractions obtained from the FPLC were analysed by SDS PAGE to confirm purity and presence of hemoglobin before subsequent mass spectrometric determination of hemoglobin chains (Yin et al., 2017). Two clearly separated peaks were observed on the FPLC chromatogram after being subjected to a pH gradient, indicating at least two different hemoglobins with different isoelectric points. Hemoglobins from both fractions separated by pH gradient were sequenced, and three different alpha and beta chains were found, suggesting the presence of at least three different isoforms. While further work is required to confirm the isoforms, upcoming studies will focus on hemoglobin autooxidation patterns, pro-oxidant behaviour in washed cod mince and characterizing structure with crystallography.

SESSION 6	**Distribution of persistent organic pollutants (POPs) in Baltic herring (*Clupea harengus membras*) and scalable routes to its removal**

OP77

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Abstract

Herring from certain regions of the Baltic Sea can contain elevated levels of persistent organic pollutants (POPs) -dioxins, dioxin-like (dl) PCBs and PFAS- which in different ways can harm human health. Very little is however known, especially for PFAS, about distributions throughout the fish and about food-grade POPs-removal processes. This study aimed at mapping levels of POPs in different parts and sizes of Baltic herring and assess how different degrees of trimming, mechanical separation and variations of mince washing could reduce their levels. Herring was caught in the Bothnian Sea during winter 2022/2023 and was divided into three size groups; from each group, a mince was then made. For larger-sized herring (30-40g size), head, backbone, fillets, guts, belly flap, tail, and skin were also separated for individual POPs analyses. Also, the larger-sized herring was subjected to mechanic meat/bone separation in the round, as well as after heading and heading+gutting. Separated meat derived from whole round fish then underwent aqueous and lipophilic washes. All samples were analyzed for total lipids, dioxin, dl-PCBs, and PFAS. Dioxin and dl-PCB levels increased with fish size and varied significantly across different fish parts. Highest concentrations were found in skin and belly flap. Heading and heading+gutting reduced the dioxins and dl-PCB concentration by 4% and 20%, respectively. When subjecting whole fish to mechanic meat-bone separation followed by two-step washing (aqueous -> lipophilic), the cumulatively reduction in levels of dioxin plus dl-PCB were 55%, 68% and 82%, respectively, compared to initial levels. Analyses of PFAS are underway, however, the results so far suggest that relatively simple and scalable processes can greatly reduce POPs of Baltic herring.

SESSION 6	**Effect of ultrasound treatment on functional and quality parameters of fish protein hydrolysate (FPH) extracted from Atlantic mackerel (*Scomber scombrus*)**

OP78

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Abstract

Fish protein hydrolysates (FPH) obtained from fish by-products by enzymatic hydrolysis allows for smart valorisation of seafood side streams. However, further treatments are normally needed to enhance bioactive and functional properties of obtained FPH. At present, the commonly used methods to improve functional properties of FPH include chemical and enzymatic modification. Chemical treatments often cause environmental problems, while the difficulty of controlling degree of hydrolysis limits the wide application of enzyme modification method. In recent years, emerging technologies such as ultrasound treatment (US) have shown great potential in protein modification with high efficiency and safety, low energy consumption, and low nutritional destructiveness. The present study as a part of IMPRESSIVE-project aims at investigating the effect of different ultrasound treatments (20 kHz, power 300W, 450W, and 600 W) on physicochemical and functional properties of FPH from Atlantic mackerel (*Scomber scombrus*). The results have shown that with an increase of ultrasound power protein solubility of FPH has increased linearly, and the changes were significant for all US-treated samples compared to control (untreated) samples. US-treatment significantly increased the degree of hydrolysis and free amino acid content of FPH samples treated with 450W and 600W compared to control samples. At the same time, it was found that the carbonyl content of FPH increased (significantly for 450W and 600W), while thiol groups decreased (significantly for 300W and 450W). The increase in total carbonyl content indicated that some US-treatments induced the oxidation of FPH. Amino acid composition of FPH has revealed that US-treatment has significantly increased the proportion of essential amino acids in the sample treated with 600W, resulting in an increase of biological value of the product. It may be concluded that ultrasound treatment of FPH contributes to a general improvement of functional properties of the product, with treatment at 600W giving the best result.

SESSION 6	**Effect of ultrasound pre-treatment prior to enzymatic hydrolysis on functional and quality parameters on fish protein hydrolysate extracted from herring (*Clupea harengus L*)**

OP79

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Abstract

High value products such as fish protein hydrolysate (FPH) and lipids rich in omega-3 fatty acids can be extracted from pelagic fish rest raw material by conventional enzymatic hydrolysis. To improve the traditionally used method of extraction, reduce costs, increase the yield, and enhance the quality parameters of the recovered ingredients, advanced non- thermal technologies can be used as pre-treatment prior enzymatic hydrolysis. Ultrasound (US) is one of the emerging non-thermal technologies. However, potential effects from the use of US such as lipid-protein and protein oxidation have to be investigated. The present study aimed at investigating the effect of US pre-treatment prior to enzymatic hydrolysis on functional and quality parameters of the recovered FPH. In total, four FPH from herring were obtained, as follows: one control without application of ultrasound pre- treatment, and three pre-treated with US (20 kHz, 600W, 900W, 1200W) prior to enzymatic hydrolysis. The results showed that the use of US increased the proportion of emulsion during enzymatic hydrolysis, resulting in a significantly lower yield of proteins from the process. However, the results of the FPH quality showed that the use US (1200W) prior to enzymatic hydrolysis resulted in a significantly higher solubility and degree of hydrolysis of the FPH. At the same time, the use of US prior to enzymatic hydrolysis did not significantly affect the proportion of essential amino acids. The highest content of thiol groups was observed in the control FPH, although it was not significantly higher compared to the FPHs treated with UL. The content of carbonyl groups was higher in the FPHs treated with US, but the difference was not significant. It can be concluded that use of US prior to enzymatic hydrolysis can increase the solubility of the proteins and degree of hydrolysis without affecting quality in terms of protein oxidation.

SESSION 6	Enzymatic activity in mesopelagic species: enhancing the quality and sustainability of the raw material

OP80

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Abstract

Mesopelagic species are considered as a valuable resource for production of ingredients for the aquaculture industry, and even as a potential food source. Most predominant species in the North Atlantic include Mueller's pearlside (*Maurolicus muelleri*), glacier lantern fish (*Benthosema glaciale*) and northern krill (*Meganyctiphanes norvegica*). Other species, such as the copepod *Calanus finmarchicus* are already being harvested and its unique lipid profile, has led to the development of several products that are marketed as dietary supplements or functional ingredients. Nutritional composition of mesopelagic species reveals a high content of marine lipids and proteins, but the presence of different species in the catch, the high and different endogenous enzymatic activity make the processing challenging. Even during frozen storage several unwanted processes can occur leading to quality deterioration. There are also biological aspects that may influence the enzymatic activity, such as spawning season, diet and maturity stage. All these make these resources very prone to degradation, and thereby fast stabilization and processing are needed to preserve the quality of the raw material. This study evaluates the proteolytic activity of endogenous enzymes of four different mesopelagic species and discusses how it could influence quality changes after harvesting and during following processing. Enzymatic activity at different pH and temperatures are evaluated to understand proteolytic activity pattern, which would allow to have better control during storage and monitor processing. To our knowledge, this is the first study tracking the enzymatic activity changes in these mesopelagic resources. The results show that by adjusting pH and temperature the enzymatic activity might be controlled what allows the use of these parameters to slow down proteolytic activity or employ them for several technological processes. This is very relevant for industrial application to preserve the quality of the raw material and thus reassure an optimal utilization of the resources.

SESSION 6	The environmental footprint and utilization potential of novel marine resources

OP81

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Abstract

The aim of the project has been to evaluate novel Norwegian marine resources for human consumption and animal feed, by estimating their carbon dioxide equivalent emissions and nutrient composition. The species analysed were orange-footed sea cucumber (*C. frondosa*) for human consumption and pearlside (*M. muelleri*) as a salmon feed ingredient. Environmental footprint calculations were estimated with a life cycle assessment (LCA) according to ISO 14044. The nutrient content analysed were lipids, fatty acids, amino acids, proteins, micronutrients, water, and ash. This was determined gravimetrically, by gas chromatography or by ion-exchange liquid chromatography. Orange-footed sea cucumber is expected to have a carbon footprint similar to terrestrial protein sources (except beef). It contains more than 100 % of the daily recommended intake of vitamin E, cobalamin, and selenium, pr 100-gram edible product. Pearlside showed potential for reducing the carbon emission of Norwegian salmon aquaculture and contains a high protein,- lipid- and omega-3 content. Any LCA is highly dependable on data availability. And, as these species are not currently utilised in Norway, the emissions need to be calculated from representable parallels in other production chains. For the orange-footed sea cucumber, there are several similar fisheries internationally that benefit the precision of the analysis. However, the lack of data for pearlside creates higher uncertainty. This preliminary research concludes that the utilisation of these species would be beneficial to expand nutritional and environmentally sustainable food and feed alternatives.

SESSION 6	SECURE: Harnessing low-trophic level marine organisms for sustainable food and health benefits

OP82

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Abstract

SECURE is an interdisciplinary project aiming to unlock the potential of Novel Low-trophic Marine Organisms (NLTMO) as sustainable food sources and nutritional ingredients. With a focus on atherosclerosis, our objective is to comprehend its influence on cardiometabolic health. We aim to devise a holistic strategy addressing both immediate nutritional requirements and broader impacts on nutritional systems and cardiometabolic outcomes. SECURE comprises six interrelated work packages: legal assessments, preclinical studies, sustainability analyses, development of novel food legislation, communication strategies and project management. A comprehensive assessment of nutrients and potential contaminants in selected NLTMO is included. NLTMO diets will be developed for preclinical studies using atherosclerosis mouse models to study cardiometabolic and microbiome changes, and gut safety. The progression of atherosclerosis will be assessed using nuclear imaging techniques. Legal reviews are conducted to facilitate the integration of alternative fishery products and NLTMO. Finally, sustainability of NLTMO food products will be compared to traditional marine products. SECURE will provide comprehensive insights on regulation, preclinical studies, sustainability, novel food legislation, and education. The legal analysis clarifies the framework for implementing new and exploratory fisheries, including assessing sustainability impacts on target species and the ecosystem, like an environmental impact assessment. Nuclear imaging in mice and the gut microbiome assessment will offer valuable insights into cardiometabolic health and gut safety. The project aims to compare the nutritional and environmental profiles of traditional seafood with NLMTO. This comparison will pave the way for integrating innovative low-trophic level foods into the market. Despite challenges, SECURE highlights NLMTO as sustainable and nutritious food sources. The project aims to foster policy dialogues, facilitate the entry of novel marine species into the market, and enhance trust in seafood consumption. SECURE addresses global challenges, including food security, environmental sustainability, and public health. By integrating marine biology, nutrition, health sciences, and legal studies, the project offers a progressive approach towards a sustainable future in seafood consumption.

SESSION 6	Mass transfer during dehydration of flounder fillet with dried kelp

OP83

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Abstract

Sandwiching a raw fish fillet between dried kelp has been traditionally developed as a sashimi preservation method in Japan. The fish fillet is mildly dehydrated, and gains taste/odor components delivered from the kelp. Thus, the mild dehydration technique with dried kelp can not only preserve a raw fish fillet but also improve its sensory properties. The changes in the texture of the fillet greatly depend on the dehydration process. In this study, the diffusion of water from a raw flounder fillet to dried kelp was investigated. Raw flounder fillets were skinned and cut into rectangles. To consider unidirectional diffusion, the dried kelp was only placed on the skin side of the fillet (not sandwiched). The time-course changes in moisture content of the flounder fillet were experimentally determined. The dehydration efficiency of the flounder fillet differed depending on the distance from the kelp; it was higher with closer to the kelp. The results indicate that the dehydration front moves slowly enough to limit dehydration in the core of the fillet. A denatured protein layer, generated through a rapid dehydration, can be a barrier to water diffusion across the dehydration front. The obtained results provide a valuable understanding of dehydration dynamics and its impact on protein denaturation, thereby fillet quality. The enhancement of protein denaturation by salt diffusion from the kelp should also be investigated in future work.

SESSION 6	Sea to pasta: an innovative food

OP84

Name: Jose Antonio Beltran **Organization:** University of Zaragoza

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Abstract

Fish is one of the most characteristic foods in several countries worldwide. Pasta is usually made with semolina or flour derived from durum wheat and drinking water, it is possible to be produced from spelt (*Triticum spelta*) or vegetables gluten free like: corn, oat, rice. All types of pasta offer great versatility, low cost, and easy preparation. Therefore, pasta appears to be an excellent option to be enriched by incorporating alternative sources of nutrients, since it is a very popular food.Our research team has developed some scientific investigations related to the use of fish by-products incorporated to pasta in order to improve its nutritional value.We have demonstrated that MDDM (mechanically deboned and dried meat) derived from sea bass trimmings could be incorporated to pasta resulting in an innovative food with high quality and better nutritional value.Pasta enriched with a sea bass by-product represents an excellent source of protein, fiber in the case of spelt pasta, due to the presence of bran, and, above all, polyunsaturated fatty acids of the Ω-3 type. The pastas developed with fish concentrate showed a stability of fat and effective protection against the oxidation of unsaturated fatty acids during the commercial shelf life studied.The use of cereals other than wheat in enriched pasta with fish could represent a good alternative to contribute to achieving the health of the consumer, especially in the coeliac and/or gluten intolerant population. According to technological, physical, and sensory parameters, gluten- free pasta made with yellow corn and rice was the most similar to the control pasta made with durum wheat.

SESSION 6	**Relationship between consumer's preference and food quality parameters for eco-friendly Seabass (*Dicentrarchus labrax*)**

OP85

Name: Juan B. Calanche M. **Organization:** University of Zaragoza

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Abstract

Nowadays seabass is one of the most important aquaculture species in Europe. The intense competition among producer countries and the market pressures to offer the best relationship between costs and benefits demand a differentiation strategy based on the quality of this fish. Sensory analysis is an essential tool in new product development to evaluate the quality and potential commercial viability, especially in environmentally sustainable areas. Thus, this research was focused on establishing key sensory properties and describing consumers' perception of farmed seabass fattened with organic feed and low fish meal inclusion rates to build a preference map for this product in the Iberic market. Four diets (Control with 30% conventional fishmeal and three different levels of replacement with organic fishmeal 25%, 30% and 35%) were studied. Sensometrics techniques were carried out by both a trained sensory panel (Torry Index -QI- and Texture Profile -STP-) and a consumer´s panel (n=100). The last one was used to carry out a hedonic test to establish the acceptability of cooked fillets for each treatment assayed. The highest QI values were established ($p<0.05$) for those treatments with 35% of replacement while STP demonstrated that elasticity, succulence, and smoothness were key attributes well associated with quantities of glutamic acid, proline, hydroxyproline, glycine and histidine in those diets with 30%. Meanwhile, the fibrousness was correlated with Palmitic acid and quantities of EPA & DHA in the treatment 25%. The acceptability of fillets belonging to treatment 30% was the highest. Both quantitative and qualitative data were used to build Preference Maps that revealed that a replacement of 35% of organic feed achieved a preference of around 20-40% in most consumers (73%). Again, these findings were influenced by the amount of essential amino acids (Lysine, Methionine & Valine) and, interestingly, by the quantities of oleic & Dihomo-γ-linolenic acids.

Posters

P01

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Abstract

The main goal of this research is to find a purpose for *Physalia Physalis,* one of the most dangerous pelagic species in the world. The initial study focused on proximate composition, fatty acid profile, lipid classes and elemental composition of the two structures of *P.Physalis*, pneumatophore and tentacles. The specimens of *Physalia physalis* were caught in Azorean coast. Regarding proximate composition, the main differences between pneumatophore and tentacles were in fat content with 7.0 ± 0.8 g/100g dw for tentacles and 3.8 ± 0.8 g/100g dw for pneumatophore and in protein with 69.5 ± 2.2 g/100g dw for pneumatophore and 58.3 ± 1.1 g/100g dw for tentacles. As expected, the moisture values were higher that 80 %. Results showed that polyunsaturated fatty acids (PUFA) were the dominant group in both structures and docosahexaenoic acid (DHA) was the most representative. Palmitic acid (16:0), the most common saturated fatty acid found in animals, was the second fatty acid with higher values with 5.9 ± 0.2 % for pneumatophore and 4.4 ± 0.9 % for tentacles. Triacylglycerol (TAG) was the major lipid class in pneumatophore (23.9 ± 3.6 %) and in tentacles (31.5 ± 3.0 %). The toxic elements values (lead and cadmium) were lower than for other jellyfish, that are already used for human consumption. All these results, compared with other jellyfish, allow to conclude that pneumatophore can be potentially used as feed. The tentacles, due to the presence of toxins will be studied for other purposes.

SESSION 1	Thinking different strategies for indexing fatty acids in fish fillets Part I: Rainbow trout as a case-study

P02

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Abstract

Fish is a source of important nutrients, such as polyunsaturated fatty acids (PUFA), particularly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Rainbow trout (*Oncorhynchus mykiss*) is the most important farmed finfish in EU, mainly raised in freshwater. As with other species, its fillet FA profile highly depends on the one of the administered feeds, since trout has a moderate ability to synthesize long chain FAs. Several nutritional indexes, such as Atherogenicity (IA) and Thrombogenicity (IT), can be calculated based on the fillet FA profile (% of total fatty acid methyl esters), whose aim is to characterize lipid quality on the basis of pro- and anti- atherogenic and thrombogenic potential of some FAs. Recently, two Healthy Fatty Indexes (HFI1 and 2) have been set considering the various classes of FAs by increasing or decreasing their relative content expressed in weight according to their health impact. The aim of the present study was to compare the effectiveness of the HFIs to the IA and IT in evaluating the nutritional differences of rainbow trout fed commercial (COM), marine ingredient- based (FISH), vegetable-based (VEG), or insect-based diets (INS). EPA+DHA content was also calculated. As expected, diet affected all indexes however, if consumers choose the best fillet based on the indexes, some inconsistencies would emerge. For instance, COM and INS had the lowest AI (0.22 and 0.24, respectively); INS and VEG had the lowest TI (0.18 and 0.19, respectively). The HFI1 calculated for VEG fish was 1.53, higher than COM ($p<0.05$), but it did not differ from INS and FISH values (1.38 and 1.43, respectively). The FISH group showed the highest EPA+DHA content, followed by VEG fish, while COM and INS had the lowest amounts of these healthy FAs. In conclusion, caution is required when using the lipid related indexes to compare fish quality, especially AI.
Thanks to European Union – Next generation EU M4C2 – Investimento 1.4 – Centri Nazionali – CN2 AGRITECH SPOKE 9 CUP B13C22001020007 for financing the Post-Doc grant of Lina Fernanda Pulido Rodríguez.

SESSION 1	Thinking different strategies for indexing fatty acids in fish fillets Part II: gilthead seabream as case-study

P03

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Abstract

The Western population considers seafood as nutritious and healthy thanks to their content in polyunsaturated fatty acids (PUFA), particularly eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids. Nevertheless, marine finfishes, such as gilthead seabream (*Sparus aurata*) have a scarce ability to synthesize long chain FAs; hence, their intake is guaranteed by the diet. Since marine ingredients have been deeply reduced in aquafeeds, a reduction of n-3 PUFA has been observed in fillets, thus lowering the health and nutritional quality in sea bream fillets. Many quality indexes are available to highlight these latter requirements, and among these, the Indexes of Atherogenicity (IA) and Thrombogenicity (IT) are certainly the most used. Recently, two Healthy Fatty Indexes (HFI1 and HFI2) have been set considering the various classes of FAs by increasing or decreasing their relative content expressed in weight, according to their health impact. The aim of the present study was to compare the effectiveness of the HFI, compared to the IA and IT in evaluating the nutritional differences of sea bream fed commercial (COM), marine ingredient-based (FISH), vegetable-based (VEG), or insect- based (INS) diets. The EPA+DHA content (mg/100 g fillet) was calculated since it is the only parameter with a suggested value, considering the positive effect on human health. No differences were obtained for TI; the best ($p<0.05$) AI was calculated for COM (0.10), followed by VEG (0.12), INS (0.17) and FISH (0.18) groups. The HFI1 index discriminated COM (1.91) and VEG (1.34) groups from the FISH (1.25) and INS (1.23) ones. Noteworthy, EPA+DHA amounts significantly differed between FISH and COM groups, while VEG and INS had intermediate content. In conclusion, HFI indexes did not seem to effectively sum up the healthy potential of sea bream lipids; thus, an inclusion of EPA and DHA in the HFIs would be useful.
Thanks to European Union – Next generation EU M4C2 – Investimento 1.4 – Centri Nazionali – CN2 AGRITECH SPOKE 9 CUP B13C22001020007 for financing the Post-Doc grant of Lina Fernanda Pulido Rodríguez.

SESSION 1	Blanching of two commercial Norwegian brown seaweeds - for reduction of iodine and other compounds of importance for food safety and quality

P04

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Abstract

The two commercially relevant kelp species, *Alaria esculenta* and *Saccharina latissima*, are both accumulators of iodine to an extent that can pose as a health concern if consumed. Water blanching is used industrially to reduce the iodine content. This study aimed to optimize the blanching conditions by investigating temperature, duration, blanching media, ratio, and recycling of water. Also, to understand if other compounds were lost during blanching. Commercial cultivated seaweed were harvested from the sea farm of Seaweed Solutions AS outside Frøya, Norway in May 2020 (salinity 33-34 ppt). After harvest, the seaweed were stored in tanks in membrane filtered, UV-treated seawater (8 °C), and the experiments conducted on the same harvest batch over a span of two to three days. Water used for the blanching experiments was either fresh water (FW) or filtered, UV treated seawater (SW). Exp. 1 explored temperatures (45 and 80 ˚C) and durations (30 and 120 s). Exp. 2 investigated the ratio of seaweed to water, while in Exp. 3, the seaweed was cut mechanically into pieces of 1-10 cm in width/length prior to blanching. Exp. 3 was only performed for *S. latissima*. In Exp. 4 the blanching and cooling liquid varied between FW and membrane filtered, UV-treated SW. The final experiment, Exp. 5, examined the effect of blanching multiple times in the same water (reusing the water). This study showed that the iodine content could be reduced by any of the blanching treatments to 85-95% (*S. latissima*) and 80-92% (*A. esculenta*) of the initial content. Seawater blanching retained more valuable compounds, such as fucoidan and magnesium, while effectively removing iodine. However, free amino acids, vitamin C and folate were lost regardless of blanching treatment. These findings are relevant for industrial scale up and to understand the compromises that occur when reducing iodine by blanching.

SESSION 1	Assessment of the biotechnological potential of three invasive seaweed species in the Portuguese coast

P05

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Abstract

The objective of the experimental work was to assess the biotechnological potential of three species of invasive seaweed in the Portuguese Coast: a green seaweed (*Caulerpa* sp.), a red seaweed (*Asparagopsis* sp.), and a brown seaweed species (*Rugulopteryx okamurae*), thereby entailing the determination of the antioxidant and anti-inflammatory activities.The invasive seaweed species *Caulerpa* sp., *Asparagopsis* sp., and *Rugulopteryx okamurae* were harvested in different locations of the Portuguese Coast and appropriately processed for further analysis. Different extracts (aqueous, ethanolic, methanolic, oily) were prepared. The proximate composition and phenolic content were analysed in accordance to standard methods. Antioxidant activity was assessed by the 2,2'-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), 2,2-diphenyl-1- picrylhydrazyl (DPPH), and ferric reducing antioxidant power (FRAP) methods. Anti- inflammatory activity was determined by quantifying inhibition of the cyclooxygenase-2 enzyme. This experimental study is part of the MSc work of Vicência Romão. The phenolic contents were substantial, namely surpassing 100 mg GAE/100 g dw in the case of *R. okamurae*. This was corresponded by high antioxidant activity in methanolic and ethanolic extracts, for instance, exceeding 50 % DPPH inhibition, while this biological activity was lower in the aqueous extracts, 48.7 ± 1.8 %. The anti- inflammatory properties were also more extensively studied in the ethanolic extracts, given their higher anti-inflammatory potential in comparison to aqueous extracts. There is an untapped biotechnological potential in these seaweed species, which may be used to supply extracts/fractions for incorporation in bio-fertilizers and nutritional supplements.

SESSION 3	Exploring the potential of the twilight zone: on the use of *Maurolicus muelleri*

P06

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Abstract

The ocean twilight zone (OTZ) or mesopelagic zone of the ocean, situated between the sunlit surface waters and the deep abyssal plains, is a vast and fairly unexplored ecosystem. Recent advancements in fishing technologies and increasing demand for marine resources have increased the interest in the potential commercial exploitation of resources living in this sea layer. This work examines the specific case of Maurolicus muelleri, a mesopelagic species currently not commercially exploited. In particular, in the frame of SUMMER project (Sustainable Management of MEsopelagic Resources, H2020 contract Nº 817806), we have studied the enzymatic hydrolysis for the production of bioactive peptides as a potential exploitation route. Maurolicus muelleri samples obtained from different scientific cruises were hydrolysed to yield valuable peptides with four different commercial enzymes and endogenous enzymes. The resulting products were characterised and tested for their bioactivity: Antioxidant, Antihypertensive and Antibacterial (7 different strains). Several positive results were obtained, and the process conditions were optimized to improve the resulting bioactivities for most promising enzyme. Pilot trials were subsequently performed in the selected optimal conditions to obtain data on process yields and to ensure process scalability. We concluded that Maurolicus muelleri is a promising source of bioactive compounds. However, further studies on the commercial process profitability, confronted with the unknown functioning of the mesopelagic ecosystem need to be undergone to ensure a sustainable use of the OTZ resources.

SESSION 3	The biological activity of the biomass of three invasive ascidians in NE Atlantic: an innovative functional food as a possible applications

P07

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Abstract

Aim: The study's aim was twofold: (i) to study the biological activity and bioactive compound content of aqueous and ethanolic extracts from the whole biomass of the ascidians Didemnum vexillum, Botrylloides diegensis, and Botrylloides violaceus (non- indigenous invasive species, which have caused high ecological and economic impacts worldwide and recently introduced in the Northeast Atlantic); (ii) to assess the possibility of using such extracts as nutraceuticals in a novel functional food. Material/methods/design: The invasive ascidian species Didemnum vexillum, Botrylloides diegensis, and Botrylloides violaceus were collected from the wild and adequately processed for further analysis. The proximate composition and phenolic content were analysed in accordance to standard methods. Antioxidant activity was assessed by the 2,2'- azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), 2,2-diphenyl-1- picrylhydrazyl (DPPH), and ferric reducing antioxidant power (FRAP) methods. Anti- inflammatory activity was determined by quantifying inhibition of the cyclooxygenase-2 enzyme. Regarding functional food, soya creams were tested. Besides a control soya cream (SC CTL), creams enriched in ethanolic extracts from D. vexillum (SC DV), B. diegensis (SC BD), and B. violaceus (SC BV) were prepared.Results and discussion: Regarding antioxidant properties, there was higher activity (and phenolic content) in the ethanolic extracts than in the aqueous extracts. Moreover, the ethanolic extract of B. diegensis had the highest total polyphenol content with 713.6 ± 14.3 mg GAE/100 g dw. The ethanolic extracts had anti-inflammatory properties with a COX-2 inhibition varying in the 58-78 % interval. The novel functional foods could be differentiated from the control in the antioxidant activity measured by DPPH and, in case of SC BV, the anti-inflammatory activity (31 ± 7 % COX-2 inhibition). Conclusion :After comparing the various properties and contents, SC BV could be considered the best functional food.

SESSION 3	**Heterotrophic growth of microalgae *Galdieria sulphuraria* on residues from aquaculture and fish processing industries**

P08

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Abstract

The present study as a part of CLIMAQUA project aimed at zero-waste utilization of fish processing streams for cultivation of microalgae *Galdieria sulpuraria*. Wastewater collected at a fish processing facility, slam (mix of used fish feed and faeces) obtained from Hofseth AS (Ålesund, Norway) and sludge after enzymatic hydrolysis of rainbow trout performed at NTNU (Ålesund, Norway), were investigated as potential sources of carbon, nitrogen, and phosphate for cultivation of *G. sulphuraria*. The main objective of the study is to develop a flexible system for the production of *Galdieria sulpuraria* biomass that can be used in a decentralized manner in the areas of aquaculture, thus contributing to regional development and the reduction of greenhouse gases. For the laboratory trials of cultivation of *Galdieria sulpuraria* biomass, 6 kg of sludge after enzymatic hydrolysis of rainbow trout along with 1 kg of fish slam and 10 kg of wastewater were used at Institute for Food and Environmental Research (Germany). Before the trials, all products were physico-chemically characterized at NTNU. The sludge extract was found to support the growth of *G. sulphuraria* when appropriate diluted, at concentrations below 40 % (v/v). It was revealed that wastewater does not impact the growth negatively, however free amino nitrogen and carbon sources need to be supplied from another source. Therefore, only proteolyzed sludge extract (20 %, v/v) was selected for upscaling and a biomass concentration of 80 g L^{-1} (growth rate was 0.72 day^{-1}) was achieved in a non-sterile fed-batch culture. Even though biomass was produced under non-sterile conditions no pathogens such as *Salmonella* sp. could be detected. The present study on better utilisation of fish processing side-streams will strengthen regional capabilities and contribute to food security and resource utilisation efficiency under climate change expected within 1.5 or 2°C until 2050.

SESSION 3	Recovery of protein and phosphorus from cod processing waters using flocculation

P09

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Abstract

The aim of this study was to recover protein and phosphorus from cod processing water. The processing water from salted cod production contains many nutrients and instead of being wasted, the nutrients can be recovered and utilized. Additionally, recovery of nutrients. especially phosphorus will reduce costs for wastewater treatment. The recovery was carried out with food grade flocculants (Levasil RD442) and Chitosan lactate using different concentrations and maturation times. The effectiveness of the process was evaluated by the amount of sedimented protein and phosphorus. Two different process waters were evaluated, one low in salt content (LS) and one high in salt content (HS) to evaluate the effect of the recovery process on waters of different composition. LS and HS did not follow the same pattern on recovery of protein and phosphorus with different flocculation treatments. Their salt contents allowed interactions through intermolecular forces with Levasil RD442. The treatment with Levasil RD442 at 1.23% without maturation period can be applied to both process waters, since this treatment recovered high percentages of protein (37% in LS and 43% in HS, respectively), and phosphorus (31% in LS and 47% in HS, respectively).

SESSION 3	Solid-phase fermentation of side streams from sugar kelp production

P10

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Abstract

The cultivation of brown macroalgae, such as *Laminaria ssp.* and *Saccharina latissima,* has increased extensively during the last decades; according to a report by Food and Agriculture Organisation of the United Nations, the cultivation of brown seaweeds exceeded 16 M tonnes worldwide as per 2019. At the Swedish West coast, the most cultivated brown alga is *S. latissima* – Sugar kelp which is mainly produced for food purposes. The *S. latissima* body consists of a blade, a stipe, and a holdfast. The hold-fast and stipe are stiff and tough and not useful for food in its raw state; instead, they become a side stream in the production. Fermentation of the stipes and holdfasts could be a way of improving their food properties, but the traditionally used and food-safe microorganisms used for fermentation of e.g. soybeans and cereals are adapted to grow on plant carbohydrates such as starch and cellulose. Since *S. latissima* is mainly composed of other carbohydrates, such as alginate, laminarin, fucoidan and mannitol, conventional fungi might not be feasible. We are now investigating a new concept of solid-phase fermentation of side-streams from *S. latissima* production by examining if different pre-treatments can make the algal carbohydrates more accessible for established and safe fungi. Four different pre-treatments are employed, followed by fermentation with two fungal strains. The goal of this project is to present a proof-of-concept – a model product – for future studies of *e.g*. microbial safety, amino acid composition, nutritional value, bioavailability, sensorics and environmental impact. In this project the visual and tactile properties of the model product is evaluated as well as the total protein content. The long-term impact target of this project is to enable sustainable and profitable valorization of a presently unused side stream.

SESSION 3	Resource-smart valorization of fish processing side streams via ultrasound-aided pH-shift processing

P11

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Abstract

The possibility of reducing the amount of fresh water used during alkaline pH-shift processing of salmon head (SH) and herring frame (HF) was evaluated with ultrasound (US) as a tool to mitigate negative effects on protein yield. The role of water ratio and US for homogenate viscosity, mass yield, crude composition, functional properties and lipid oxidation of the SH and HF protein isolates were also investigated. Applying US during the solubilization step of the pH-shift process completely compensated for the reduced protein yield coming from using 3 rather than 6 volumes of water for HF, but not for SH. Using US had no negative effect on the composition and protein functionality of the HF protein isolate. However, it slightly increased its level of secondary lipid oxidation products. Altogether, applying US during pH- shift processing at low water ratios can be a promising solution for more resource-smart valorization of herring side-streams.

SESSION 3	Marine fishery discards as raw pet food for a sustainable Europe – innovative curriculum development

P12

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Abstract

The present project aims to develop an innovative curriculum to reduce marine fishery discards (MFD) and to evaluate the MFD's potential to be used as biologically appropriate raw food" (BARF). Moreover, we aim to improve the sector's ecological and economic sustainability by implementing the project's multidisciplinary approach. The most innovative aspect of the project is that it creates the first vocational training curriculum on the production of BARF for pet animals from discarded marine fish. A survey to elaborate on the state-of-the-art related to MDF and BARF was distributed among European stakeholders. The state-of-the-art knowledge was used as a fundament for designing the learning outcomes and curriculum. A literature study was then performed to optimize the training and learning methodology. Moreover, a multidisciplinary approach was used to develop the five modules identified as core subjects for the curriculum. The initial mapping identified a knowledge gap related to MDF and the potential of using MDF as raw materials for BARF pet food among professionals along the value chain from Fishermen, fish-dealers, and the processing industry to consumers, pet-owners, and veterinaries. Industry-relevant cases, podcasts, and training activities have been developed to support the learning outcome. Moreover, five modules have been developed to fill the identified knowledge gap and will work as the curriculum's knowledge hub. These modules are i) An introduction to discard fisheries and evaluation; ii) Discarded species in the fishery and suggested methods to reduce; iii) Innovations in the processing of discarded fisheries; iv) Use of discard fisheries to produce pet food and v) Biosecurity, hygiene, and EU legislations for the discard fisheries processing and end products. A guidebook will be developed, and the project group aims to launch the curriculum for free through an online platform in 2024. The project is supported by the Erasmus+ grant number 2021-1-TR01-KA220-VET-000024755.

SESSION 4	Consumer awareness and perceptions of the use of fish processing by-products in bio-fertilizers production

P13

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Abstract

Finding out the knowledge and current attitudes of people towards the use of fertilizers made from organic wastes and determining the main factors that may affect their acceptability in relation to the organic production is critical to ensure the market uptake of plant products treated with biobased fertilisers produced with fish processing by-products. With this aim, an online consumer survey was done in the European countries represented in the H2020 SEA2LAND project: Spain, Italy, France, Estonia and Norway (n= 300 x 5). Southern countries appear as more prone to consume products treated with organic fertilizers obtained from fishery waste while northern ones seem less aware of and interested in organic production. the statement with which more people agree is that of organic fertilizers are better for your health than artificial or synthetic fertilizers. The motivations towards the use of organic fertilisers appearing among the top four in all countries are common: the products are healthier for your health; they have lower environmental impact and are of better quality. However, the responses indicated that the ranking of the motivations differ between countries. On the other side, total consensus was found related to the barriers, where the main topics to cover to surpass them should be a transparent communication, correct labelling, demonstrate that they do not affect product safety and taste and producing them at a competitive cost that do not increase the price of the products. As an overall conclusion, slightly different strategies should be considered when promoting BBF into different countries due their different perceptions and expectations.

P14

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Abstract

Salmon feed produced in Norway has global and complex supply chains. In 2020, 92% of salmon feed ingredients in Norway were imported. With increasingly higher demand for food and animal-based proteins, sustainable value chains are important to reduce negative environmental, social, and economic impacts. The SusFeed project, financed by the Norwegian Research Council (grant number 326825), aims to increase raw material for feed produced in Norway and investigates the potential of novel feed ingredients. To investigate and assess the sustainability and robustness of the feed system, a holistic perspective on the system is needed. We aim to conceptualize and quantify the current value chains of feed in Norway using food systems approach (FSA) and material flow analysis (MFA). We created a conceptual model based on the FSA, including the supply chain of the feed, regulatory environment, customer characteristics, and connected service industries. Quantification of the feed system was done based on an MFA, a useful methodology to assess the resource efficiency of a system. The system boundaries were from feed ingredient to edible salmon product in Norway in 2020, and the system was quantified for total mass, protein, and energy in the feed. Understanding of socio-economic and environmental drivers for the transition towards the future feed system is important input for key stakeholders. There is no mention of feed in the UN Sustainable Development Goals (SDGs), however, many Norwegian feed and animal producers link their sustainability work to the SDGs. Our findings show that current regulations constitute barriers towards increased use of rest raw materials and food waste as substrate insect production, that could be ingredients in salmon feed. It is important that new ingredients fulfil the animal's nutritional requirement. Therefore, knowledge on the current feed system can help identify where improvements and replacement of ingredients can be done.

SESSION 4	How environmental factors influence the fish products purchase decision

P15

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Abstract

The objective of this work was to determine the importance of different factors, such as sustainability/environmental certification, price, and the use of sustainable packaging, in the purchase decision of fish products. For this purpose, an online survey was conducted using the Google Forms platform. In this survey, the purchase preference for canned tuna and fresh salmon was evaluated through a Conjoint Analysis. For both canned tuna and fresh salmon, 3 attributes were studied: price, production system or sustainability fishery certification, and sustainable packaging. According to the results obtained, the factor with the highest impact on the purchase decision was the presence of a sustainability seal related to the marine environment. The importance placed on the production method and sustainability certifications was higher in fresh salmon than in canned tuna. In the case of canned tuna, positive utility values were obtained for the low price, sustainable packaging, and certifications related to the sustainability of the marine environment. In the case of fresh salmon, the highest utility value was obtained by fishery certifications. The lowest utility value was for "aquaculture product" which would indicate that consumers prefer wild fish over farmed fish, although the "Aquaculture Stewardship Council" certification (ASC) would reduce the negative impact that aquaculture production has on consumer opinion. The results obtained in this study show the consumers' preferences in relation to fish products and which factors are important for the fish products purchase decision. Our findings reveal how marine sustainability certifications can be an incentive to purchase fish products.

SESSION 4	Explaining consumers' behavior towards fish welfare: The role of empathy in extending the value-belief-norm model

P16

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Abstract

A few studies have tried to understand behaviour towards animal welfare. However, there are indications that consumers make an important distinction between land animals and fish. As no studies have attempted to explain the factors that can explain consumer behaviour towards the welfare of fish, this study aims to explain the behaviour by using the value-belief-norm model. In addition, we extend the model by using empathy as a factor influencing the formation of personal norms. This study argues that by adding empathy as an emotional factor in the model, we will improve the ability of the VBN to explain moral behaviour. Practically, this study will explore consumers' beliefs towards fish welfare and identify consumers who are more likely to purchase fish with better welfare because of their values. Design/methodology/approach: The study is based on survey data of 600 Norwegian consumers. Confirmatory factor analysis is used to assess the validity of the latent variables (value, belief, norm, empathy and intention). A structural equation modelling analysis with latent constructs is used to test the hypotheses. Findings: We expect to validate the ability of the VBN model to explain consumer intention to buy fish with better welfare. We also expect that the introduction of empathy improves the explanation strength of the model. Practical implications: By understanding the role of empathy, companies can develop marketing strategies that appeal to consumers' values, empathy and beliefs and ultimately encourage them to make purchases that support fish welfare. Originality value: The contribution of this study is twofold. First, this research develops a more comprehensive VBN model to explain moral behaviour by introducing empathy as an emotional factor to a cognitive model. Second, it explains consumers' behaviour towards fish welfare.

SESSION 4	Knowledge and perception of teenagers regarding fish products

P17

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Abstract

The objective of this work was to determine the level of knowledge and perception of teenager consumers about fish products. For this purpose, surveys were conducted at a high school in the Valencian Community to teenagers (12-17 years old), which included 5-point hedonic scales and questions related to fish and aquaculture. A completion technique was also included in the questionnaire to determine the parameters that positively or negatively affect fish consumption. Nuggets, hamburgers, pâtés and croquettes were the best-valued products. The inclusion of seaweed in fish products decreased the acceptability scores. 85% of respondents agree that fish is a healthy product and 63% of them know that it should be consumed several times a week. 45% of teenagers surveyed do not know that fish can come from aquaculture. Among respondents who know farmed fish, the majority stated that this is more environmentally friendly than wild fish, while the majority did not know if this is safer, better for animal welfare, healthier or if it has better sensory characteristics. Regarding the attributes that negatively affect fish consumption, fish bones were the most important parameter for teenagers, who stated that they would eat more fish if it had better sensory attributes. This study confirms that the development of new fish products for teenagers should focus on formulations free of fish bones. The administrations together with the fish sector should design information campaigns in order to improve the knowledge of fish and aquaculture, including aspects of health and sustainability to increase responsible fish consumption among young people.

This study is part of the ThinkInAzul program financed by MCIN with funds from the European Union NextGenerationEU (PRTR-C17.I1) and by the Generalitat Valenciana (GVA-THINKINAZUL/2021/004).

SESSION 4	The catch welfare platform: a multidisciplinary approach for improving fish welfare in global fisheries

P18

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Abstract

The welfare of caught fish is gaining increasing attention, necessitating an assessment of current practices in the fisheries industry. This project emphasizes the importance of a collaborative effort involving seafood-related industries, research organizations, and NGOs to address this issue on a global scale. Currently, such a multidisciplinary collaboration for major fisheries worldwide is lacking. The primary objective is to establish and coordinate the Catch Welfare Platform (CWP), a network of multidisciplinary teams aimed at expediting the transition in world fisheries towards practices and technologies that enhance the welfare of the catch, including post-capture slaughter. The CWP will address critical challenges in transitioning global fisheries, including characterizing capture-related hazards, defining scientific principles and tools for implementing good catch welfare, understanding technical and socio-economic barriers, and facilitating stakeholder engagement and public awareness through effective communication and education. The transition will prioritize fishing practices that minimize physical damage and allostatic load on the animals. The active participation of seafood-related industries, including fishers, is crucial to accelerate this transition. Incentivizing fishers, such as through the valorisation of seafood products adhering to good catch welfare standards, is a key consideration. The work will be conducted within the framework of the One Welfare concept, which recognizes the interrelationships between animal welfare, human well-being, and environmental conservation.

SESSION 4	Consumer segments and their responses to fish welfare issues

P19

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Abstract

The aim of this study was to identify consumer segments based on their involvement with environmental and welfare issues and define how that influences their attitudes and willingness to pay for fish with improved welfare. This study is based on a consumer survey of a representative sample of 500 participants from Norway. The variables measures were involvement with environmental issue and welfare, consumer attitudes towards fish welfare and willingness to pay for products that use fish that had improved welfare. A segmentation analysis will take place to identify consumer groups regarding involvement. The groups will then be tested using Analysis of variance to identify significant differences in their attitudes and willingness to pay for improved welfare. We expect to find consumer segments that vary in involvement, but also in consumption behaviour, knowledge and sociodemographic characteristics. The literature has extensively examined consumer behavior towards farmed fish welfare, yet there is a lack of research on the welfare of wild fish. Therefore, this study represents an additional effort to investigate consumer behavior towards the welfare of wild fish. This study is expected to show that there are consumer segments that also value fish welfare when it comes to wild fisheries catch. We expect to show how the results can influence future market decisions regarding these issues and how future labelling can make use of that in terms of communication towards the consumers. There is room for expanding the market towards adding value by providing information about wild fish welfare. This study is expected to support this direction and promote the potential of profit for relevant companies, while improving the welfare of the fish, the image of fisheries and the conscience of the consumers.

SESSION 6	Development of an infusion method to enhance moisture retention in cod loins: Testing a combination of 2.6% (w/w) NaCl and protein hydrolysates

P20

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Abstract

The aim was to develop an infusion method (similar to pork and chicken in the food industry) for fish, to enhance the moisture retention, and potentially juiciness, during cooking. This method would be used to test different ingredients and their potential to retain moisture in cod loins. The method was developed and optimized for injection of 10% (w/w) solution with 5.0% (w/v) NaCl (including refrigerated resting time in 5.0% NaCl solution for 60 min), which was used as a "golden standard" with a water holding capacity of 5.0 g water/g dry weight (gw/gdw). The goal was to obtain similar moisture retention when removing or reducing the salt content of the injection and resting-solution and instead including other water-holding ingredients, e.g. fibers or peptides. The water holding capacity (WHC) was determined for the treated raw cod filets as a measurement for moisture retention. The ingredients tested were fish collagen and potato protein hydrolysates (KMC). Results showed that by reducing the NaCl concentration from 5.0 to 2.6% in the injection and resting-solution the WHC decreased to 3.3 gw/gdw. However, by combining of 0.1% (w/v) protein hydrolysate (both collagen and KMC) and 2.6% NaCl in the infusion solution (including refrigerated resting time in 2.6% NaCl solution for 60 min) WHC improved 15.4%. The potato peptides showed a WHC in the cod filets of 3.9 gw/gdw compared to fish collagen with a WHC of 3.8 gw/gdw. Results indicate that WHC can be improved by combining NaCl and peptides, in the aim of reducing NaCl in the final product. Onwards, cooking loss of the treated cod filets will be investigated to study the connection between moisture retention in the raw cod filets and juiciness in the cooked product.

SESSION 6	Antioxidative role of lingonberry press cake during pH-shift processing of sensitive fish rest raw materials

P21

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Abstract

We recently reported on the concept of combining fish-based and plant-based side streams in the pH-shift process as a route to mitigate oxidation of the fish lipids. Among tested plant-based side streams, lingonberry press cake (LPC) was the most antioxidative, and even at 2.5% (dw/dw) addition ratio to herring side streams, it provided protein isolates free of oxidation. Knowledge has however been missing on what molecules/fractions of the LPC that are the most profound antioxidants, which we aimed at answering in this study. LPC was pH-shift-processed alone aiming at the same pH-cycle as was used when LPC was combined with fish (pH 3.05→pH 12→pH 5). The obtained LPC fractions were then subjected to total phenolic content (TPC), antioxidation capacity and anthocyanin analyses; the two latter also after solvent fractionation. Antioxidant capacity was tested both in vitro and in hemoglobin (Hb) fortified washed cod mince (WCM). LPC lost 23.7% TPC when the alkali-soluble fraction was recovered while there was no significant further loss when adjusting it to pH 5 and centrifuging ($p > 0.05$). Crude LPC and the fraction staying soluble at pH 5 most effectively inhibited Hb-mediated lipid oxidation of the WCM, which was not predicted by the in vitro tests FRAP and DPPH. Proanthocyanidin A1 and cyanidin 3-O- galactoside were identified as the most potent LPC-antioxidants in the fraction staying soluble at pH 5, however, stronger inhibitory effect on Hb-mediated WCM-oxidation was obtained from the full LPC/LPC-fractions, pointing at a cocktail effect. Results gave valuable understanding of the LPC-antioxidants which are co-extracted together with muscle proteins during pH-shift processing of fish filleting side streams. They also support further exploring of berry side streams as natural antioxidants in sensitive fish raw materials to comply with clean label.

SESSION 6	Development of fish pâté with fish bone powder and seaweeds

P22

Name: Isabel Fernández-Segovia **Organization:** Universitat Politecnica de Valencia

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Abstract

This research aimed at developing healthy and sustainable seabream pâté products with appropriate sensory properties. Fish bone powder or flour was obtained from seabream (*Sparus aurata*) by-products. The fish was filleted and fish bones were submitted to a process of different stages: boiled in water, drained, pressed with cheesecloth, grounded, dried at 60 °C, milled and sieved. Different pâté formulations were developed: C (control samples with seabream flesh, salt, powdered milk, olive oil and water), B (samples C where part of the seabream flesh was replaced by 10% of fish bone powder), B-P (samples B in which part of the fish flesh was replaced by pea protein), B-P-S (samples B-P with a combination of seaweeds), B-S (samples B with a combination of seaweeds) and B-Sp (samples B with *Spirulina*). Physico-chemical and microbiological characterization were carried out, as well as sensory evaluation of the samples. The inclusion of by-product flour in the formulations increased the protein content of the pâtés, as did pea protein and *Spirulina*. No *Enterobacteriaceae* and low counts of mesophilic bacteria were found in the pâté. In the sensory evaluation, all the samples were scored above 5 in a 9-point scale, with no significant differences between them, with the exception of the B-Sp sample, which obtained significant lower scores in all the evaluated attributes, except for odour and texture. With the inclusion of fish bone flour, pea protein and seaweeds in the fish pâté, healthy and sustainable fish products have been obtained. This study is part of the ThinkInAzul program financed by MCIN with funds from the European Union NextGenerationEU (PRTR-C17.I1) and by the Generalitat Valenciana (GVA-THINKINAZUL/2021/004).

SESSION 6	Surimi gels formulated with antioxidant coconut oil emulsions stabilised by chitosan nanoparticles

P23

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Abstract

Coconut oil emulsions were incorporated in surimi gels to obtain a new product with unique textural and flavour properties, far away from those of typical fish gels that may be disliked by some consumers. However, the highly saturated fat of coconut oil makes its use controversial in food. Therefore, chitosan nanoparticles were used to decrease the lipid digestibility of coconut oil emulsions and provide antioxidant capacity. Empty (NP) and quercetin-loaded (NPQ) chitosan nanoparticles were prepared using TPP as crosslinking agent and ultrasonication. Quercetin was added at 10.5% with respect to chitosan. The W/O emulsions were obtained by homogenising NP and NPQ suspensions with the coconut oil (30:70) in Ultraturrax. A control emulsion (C) was prepared with water. Different Alaska Pollock surimi gels were obtained by homogenizing the protein with 1% NaCl, mixing with the three types of emulsions at 25% concentration, and heating at 65°C. Both NP and NPQ suspensions showed similar ζ potential (40 mV). The quercetin increased the particle hydrodynamic diameter (from 226 to 350 nm) and the antioxidant properties. Both NP and NPQ improved the emulsions flow and viscoelastic properties at 25°C, as well as their antioxidant capacity. A simulated in vitro gastrointestinal digestion denoted the ability of chitosan nanoparticles to decrease the lipid digestibility in the corresponding emulsions. The addition of NP-containing emulsions to surimi gels decreased slightly the water holding capacity, hardness and gumminess with respect to the gels added with the control emulsion. The presence of NPQ decreased the gel whiteness. A new product with a pleasant coconut flavour was obtained based on the addition of emulsified coconut oil, whose lipid digestibility was partially attenuated by the presence of chitosan nanoparticles.

SESSION 6	**Effect of simulated gastrointestinal digestion on bioactive properties of *Holoturia foskalii* hydrolysates encapsulated in two nanostructure systems**

P24

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Abstract

The objective of this work was to evaluate the encapsulation effect of a sea cucumber hydrolysate in two types of nanostructures. The hydrolysate was obtained with alcalase (2 h/50 ºC, pH 8). and was subsequently encapsulated in rapeseed lecithin nanoliposomes and chitosan nanoparticles. The hydrolysate-loaded nanostructures were characterised (particle size, ζ potential and encapsulation efficiency) and their biological activities: antioxidant activity (ABTS, FRAP and Folin-reactive substances) and antihypertensive (ACE inhibition) determined before and after in vitro gastrointestinal digestion. The encapsulation of the hydrolysate was more efficient in nanoliposomes, which presented a highly electronegative ζ-potential and smaller particle size than chitosan nanoparticles. After an in vitro simulated gastrointestinal digestion, an increase in Folin-reactive substances and antihypertensive activity was observed in both nanostructures, while an increase in antioxidant properties (ABTS and FRAP) only occurred in the case of nanoliposomes. In summary, the bioactive properties of encapsulated Holoturia forskalii hydrolysates can be increased after a simulated digestion process.

SESSION 6	Potential mucoadhesive capacity of chitosan nanoparticles and rapeseed lecithin liposomes

P25

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Abstract

Encapsulation in polymer nanoparticles is a recognised method to improve the oral bioavailability of hydrophobic and hydrophilic compounds protecting them from degradation in the gastrointestinal tract, while facilitating their permeability through mucous membranes. Polymer nanoparticles are widely used in the pharmaceutical industry for oral delivery to enhance mucoadhesive and mucus penetration capacity. Due to their biodegradability, biocompatibility and non-toxicity, mucoadhesive nanoparticles have gained interest in recent years for potential food applications. This work aimed to evaluate the potential mucoadhesive capacity after in vitro gastrointestinal digestion (GID) of two types of nanostructures: chitosan NPs (Chi-NPs) and liposomes (L), both empty and loaded with a sea cucumber hydrolysate. The hydrolysate was obtained with Alcalase (2 h/50 °C, pH 8). The Chi-NPs were obtained using the dropwise addition of TTP as cross-linker. Liposomes were prepared with rapeseed lecithin. In both nanostructures, 0.36 g of hydrolysate was added. GID was performed according to the harmonised INFOGEST protocol. Mucoadhesive properties were determined in terms of viscosity, particle size and ζ potential. Steady shear viscosity, used to evaluate the interaction between liposomal and nanoparticle digests with mucin, showed an opposite effect, increasing for L and LH and decreasing for Chi-Np and Chi-NP-H. The decrease may indicate interactions with mucin through the formation of soluble complexes that decreased the hydrodynamic volume of the mixture at the end of the intestinal phase. The ζ potential of Chi-NPs (with and without H) became more electronegative, which may indicate greater interaction with mucin favoured by greater partial deprotonation. Incubation with mucin resulted in a marked decrease in the size of the NPs aggregates (with and without H) denoting chitosan-mucin interaction, which was not observed in liposomes. Chitosan NPs showed mucoadhesive properties, being higher when loaded with the hydrolysate; in contrast, liposomes did not show this property.

SESSION 6	Mitochondria as targets for quantifying seafood quality by measuring the production of reactive oxygen species

P26

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Abstract

Seafood quality can also be linked to the level of oxidation of the food matrix. The production of super-oxidized compounds by mitochondria will contribute to the oxidation of lipids and proteins in the food matrix. These oxidation mechanisms contribute to the nutritional loss of seafood. Mitochondria, the main site of oxidation, may therefore be a prime target for measuring the level of oxidation in these products. The aim of this study was to measure the production of ROS (Reactive Oxygen Species) by mitochondria isolated from sea bream (Sparus aurata) fillets stored at 4°C. ROS production was measured using a fluorescent probe: Amplex Red. The level of ROS production by mitochondria depended on their physiological state. The carbonylation level of mitochondrial proteins isolated from sea bream fillets was measured using the DNPH (Di-Nitro-Phenyl Hydrazide) method and the fluorescent probe CF633 Hydrazide. The level of mitochondrial protein carbonylation increased with the length of time sea bream fillets were stored at 4°C. These results showed that mitochondria can be good sensors of seafood oxidation levels.

SESSION 6	Formation and characterization of sodium alginate/sodium caseinate nanoparticles for curcumin

P27

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Abstract

Aim research: Curcumin (CUR) is a polyphenol extracted from turmeric possessing antioxidant, anticancer, anti-inflammatory and anti-aging activities. However, CUR has low solubility and undergoes rapid degradation. The interaction of the two major food biomacromolecules protein and polysaccharide has gained recent attention as a potential delivery system for CUR. Materials and methods: We have studied protein-polysaccharide interaction of sodium caseinate (NaCas) and sodium alginate (Alg) in the presence of citric acid (CA) (2%, w/w), as function of pH, total biopolymer concentration (TBC), molar ratio of NaCas to Alg. The binding characteristics of NaCas, Alg and NaCas-Alg with CUR were studied by fluorimetry technique, as well as in terms of particle size distribution and zeta potential by dynamic light scattering. The encapsulation efficiency and stability of NaCas-Alg with CUR were studied for up to 8 days at room temperature at different CUR and Alg concentrations. Finally, the effect of NaCas-Alg on CUR antioxidant activity was be studied. Results and discussion: The fluorescence study demonstrated improved binding of CUR with NaCas in CA as well as interaction with Alg possibly due to cross linking. The NaCas/Alg molar ratio affected CUR stability demonstrating different destabilization mechanisms, also influenced by CUR concentrations. The charge neutralisation was observed at NaCas/Alg molar ratio 5 at pH 3.5 where the particle size distribution indicated the formation of larger aggregates, molar ratio 20 exhibited a homogeneous particle distribution with PDI ~0.2 and reduction in particle size with CUR. In addition, the effect of pH and TBC on NaCas-Alg interaction and CUR encapsulation will be discussed in detail. Conclusions: NaCas - Alg interaction as affected by pH, TBC, NaCas to Alg molar ratio determined the final efficiency and stability of CUR encapsulation in NaCas – Alg nanoparticles.

SESSION 6	Incidence, bioavailability, and mitigation strategies for mycotoxins in farmed fish and feeds: Gilthead seabream as case study

P28

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Abstract

In the last years, the profitability and sustainability of the aquaculture sector has been addressed, with strong efforts being made to replace ingredients from animal sources (fish meals and oils) traditionally used in aquafeeds, by vegetable sources (e.g., cereals). However, this strategy may raise negative implications, as cereals (e.g., corn, wheat) commonly used in aquafeeds often contain high levels of toxic metabolites produced by fungi, i.e., mycotoxins. Consequently, a higher incidence of mycotoxicosis in fish is expected to occur, which can ultimately cause adverse health effects in animals and humans. Little is known about the effects of ingestion of contaminated feeds with mycotoxins by fish, as well as the effects on their gastrointestinal tract (GIT) and absorption efficiency in the gut, thus remaining a serious food safety concern. Within this context, MycoFish project (PTDC/CVT-CVT/2660/2021) addresses this topic with the main goals: i) assess regulated and emerging mycotoxins' incidence in feed ingredients and aquafeeds; ii) evaluate *in vivo* bioaccumulation and toxicity of the most relevant mycotoxins to farmed fish; iii) develop and optimize models allowing the *in vitro* simulation of nutrients/contaminants bioaccessibility and bioavailability in fish GIT, with subsequent *in vivo* validation; and iv) assess the potential human health risks from mycotoxins exposure and propose mitigation strategies to reduce mycotoxins toxicity through the use of natural detoxifying antioxidants. This innovative project joint efforts of 3 renowned research organizations (IPMA, MARE-FCUL and REQUIMTE) with expertise in aquaculture, food safety and optimization/validation of analytical methods. Overall, MycoFish outcomes are expected to enable the optimization of protection of consumers and fish farmers, with the delivery of safe and high quality products for consumers.

SESSION 6	Utilization of Atlantic lumpfish (*Cyclopterus lumpus*) skin as a source for gelatine extraction

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Abstract

The aim was to valorise underutilised lumpfish skin to extract gelatine and evaluate the effect of extraction parameters on the yield and biochemical and physical characteristics. Material/methods/design: Frozen post roe extraction lumpfish carcass received from Royal Greenland AS and Biopol/University of Akureyri were used for the study. The skin pieces were initially deproteinized (0.1N NaOH) and demineralised (0.1N HCl). The pre-treated skin samples were divided into 27 experimental units for extraction based on acid to skin ratio, reaction temperature and reaction time and further freeze dried to isolate the gelatine. Yield, proximate composition (ash, dry matter, lipid and protein content), amino acid composition and hydroxyproline content of the different fractions of the lumpfish carcass were determined to assess the raw material. For the extracted gelatine the yield, dry matter, protein, total amino acid, hydroxyproline, molecular weight distribution by SDS PAGE and rheological properties by Oscillatory rheology evaluation was determined. Results and discussion: The proximate and amino acid profiling of the lumpfish skin indicated a high protein and glycine content (30% of the total amino acids). A maximum gelatine yield of 40% on dry weight basis was reported with the gelatine having a hydroxyproline content of 7.2%. The SDS PAGE analysis confirmed the presence of gelatine peptides with high molecular weight (>100 kDa). The rheological properties indicated a lower gelling and melting temperature, storage modulus and viscosity for lumpfish gelatine compared to conventional terrestrial gelatine but comparable to cold water fish gelatine. Conclusion: The study successfully demonstrated that the otherwise underutilised lumpfish carcass could be used as a raw material for extraction of fish gelatine using acid hydrolysis resulting in value addition of lumpfish side streams generated after roe harvesting.

SESSION 6	Lipid oxidation during ensilaging of salmon by-products and effect of pH and antioxidants

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Abstract

Ensilaging is both a preservation and processing method used to process fish by-products into ingredients like lipids and proteins. Obtained ingredients by ensilaging can be used for feed and other applications. The process is simple, grinded by-products are mixed with acid to keep pH below pH 4 to prevent microbial growth. Endogenous enzymes present in by-products autolyze the raw material depending on pH, temperature, and time. The aim of this work was to study how a pH below 4 influences the quality of lipids and proteins during storage of silage of salmon viscera and if added antioxidant can influence quality changes. Salmon viscera was mixed with commercial formic acid mixtures with no antioxidant and with antioxidant (mixture of propyl gallate and butylated hydroxyanisole). Different amounts of formic acid were added to get the pHs: 3, 3.5 and 4. The silage was stored for 4, 11, 18 and 25 days. The changes in lipids (both hydrolytic and oxidative) were analyzed both by high field NMR and traditional oil quality methods: free fatty acids, peroxide value and p-anisidine values. The protein changes were analysed by high field NMR. Proteolytic and lipolytic activity in silage were also analysed. The results showed that free fatty acids formation increased with increased silage pH. Lipid oxidation increased with storage time. In the beginning of ensilaging, lower oxidation product amount was obtained in lipids from ensilaging with antioxidants. Moreover, a lower amount of oxidation products was also obtained at pH 3. However, oxidation developed during storage and after the 11th day of storage there was no effect of pH or antioxidant on the amount of oxidation products in the oil. The proteases were active at pH 3-4 and a clear pH effect was not obtained. The dry matter content increased in the water-soluble protein phase. The content of small peptides in the silage also increased during storage with no clear effect of pH.

SESSION 6	The influence of physical and geometrical changes on the insulation and strength of expanded polystyrene food packaging

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Abstract

Expanded polystyrene (EPS) boxes with a capacity of 3 kg are used to transport fresh fish in Iceland because of its good insulating and mechanical properties. The boxes should be strong enough to withstand the rigors of transportation and handling, thereby preventing damage to the seafood during transit and maximizing storage life of fresh seafood products. The primary aim of this project is to design lightweight EPS boxes that are sufficiently strong without compromising insulation. Given that the static stacking is the most common scenario in the shipping system, the impact of physical and geometrical modifications of the EPS box on the thermal and mechanical performance in this scenario are studied numerically. The modifications include changes in density, height, wall thickness, and radius of corners. A total of six parameters are analyzed. In the structural analysis, the critical force of the buckling on the long side wall is chosen as an indicator for the strength, and the ratio of percent modification to percent mass or strength change is defined as relative sensitivity. The results show that the change in density is the most sensitive to the weight and the strength of the box, whereas the modifications in the radius of corners are the least sensitive. In addition, all the modifications have an influence on the insulation property to a certain extent. To summarize, the modifications in the density, the height, and the thickness on the short side wall are encouraged, however, case is reversed for the radius on the outside corners and the thickness on the long side wall.

SESSION 6	Fermentation of Green Crab (*Carcinus Maenas*) for human consumption

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Abstract

This study aims to investigate the feasibility of fermenting green crab (*Carcinus maenas*) with selected strains of lactic acid bacteria (LAB) and nutrient-rich side-streams as a sustainable solution to address concerns about their potentially harmful impact on the environment while providing a novel food source for human consumption. Using green crabs for fermentation could reduce their population, support coastal communities, and promote sustainability by providing an alternative to overexploited seafood sources. Green crabs were collected from the Danish coastal area and were stored frozen at the Technical University of Denmark (DTU). The fermentation process involved the use of lactic acid bacteria strains, belonging to the DTU strain library, selected for their high acid production and the application of carbohydrate-rich side-streams to ensure a successful fermentation. Biological samples of the crabs were taken throughout the fermentative process for analysis of gross and microbial composition.In order to achieve optimal results, a screening was implemented to evaluate 96 LAB strains isolated from environmental samples. The objective was to identify strains that demonstrated a high capacity for organic acid production. A total of 5 strains were ultimately selected based on their ability to acidify the considered side-streams to a pH level below 4. Throughout the 120-hour fermentation period at 20°C, two candidate strains effectively maintained a pH level below the threshold of 4.5, adhering to food safety standards. Although the project is still in its early stages, the results obtained so far are promising with respect to the food safety aspects of the product, elongating the shelf life of the raw material and reducing the presence of pathogens. Further research should explore consumer acceptance and optimize the fermentation process to ensure its viability on a larger scale.

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