AlgeCenter Danmark

11TH NORDIC SEAWEED CONFERENCE

INNOVATIVE APPLICATIONS OF SEAWEED

FOOD – HEALTH – FEED – MATERIALS – NATUREBASED SOLUTIONS

ABSTRACT BOOK

12th and 13th of October 2022
Kysthotellet
Grenaa, Denmark

ALGECENTER DANMARK IS:
- Aarhus University
- Danish Technological Institute
- The Kattegatcenter

WE WORK WITH:
- Green solutions
- Circular Bioeconomy
- Research
- Business development
- Dissemination

WE FOCUS ON CULTIVATION AND USE OF MACROALGAE FOR:
- Biomitigation of nutrients and CO_2
- Food
- Feed
- Energy
- Plant health & fertilisers
- Ingredients
- Bioactive components
- Materials
- Art

WE FOCUS ON THE ENTIRE VALUE CHAIN:
- Cultivation & cultivation technology
- Pre-treatment & processing
- Product development
- Legislation

ALGECENTER DANMARK FACTS:
- Established in 2010
- Active industrial network
- Laboratories in Aarhus, Taastrup and Sdr. Stenderup
- On-land pilot-scale cultivation facility (12 tanks) at Grenaa Harbour
- Twenty hectare off-shore cultivation site in the sea (Kattegat) near Djursland in cooperation with The Danish Coastal Authority
- Annual international conference in Grenaa: Nordic Seaweed Conference – Macroalgae from research to Industry
- National and international research and development projects ranging from small projects to large EU projects
- Collaboration with industrial partners ranging from SMEs to large industries, education and research institutions

Front photo: Peter Bondo Christensen, Aarhus University

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Thanks to Food & Bio Cluster Denmark, Centre for Circular Bioeconomy Aarhus University and Danish Korean Blue BioCluster Alliance for supporting the conference!

CBIO CENTRE FOR CIRCULAR BIOECONOMY

Food & Bio Cluster Denmark

AlgeCenter Danmark

12TH NORDIC SEAWEED CONFERENCE

SEAWEED FOR EMISSION CAPTURE & UTILISATION

PROGRAMME WEDNESDAY 11TH OCTOBER:

10.00 – 11.00 REGISTRATION
11.00 – 11.15 Welcome

SESSION 1: SEAWEED FOR EMISSION CAPTURE: CULTIVATION

11.15 – 11.45	Keynote talk: The Use of Ulva in Integrated Multi-trophic Aquaculture (IMTA), an Ecological Approach for A Sustainable Aquaculture. Dr. Muki Shpigel, Professor of Marine Sciences, University of Haifa, Israel.	#1
11.45 – 12.00	Sugar kelp cultivation in the north of Norway, James Philip, Senior scientist, Nofima, Norway	#2
12.00 – 12.15	Effects of population and photoperiod on early sporophyte growth in Sugar kelp. Marie Lillehammer, Research Scientist, Nofima, Norway.	#3
12.15 – 12.30	Establishing a Wet-Based, Organic-Certified Supply Chain for SEAFLOUR, Morten Hørby Pedersen, scientist, International Flavors & Fragrances, Denmark.	#4

12.30 – 13.30 Lunch

SESSION 1, CONTINUED: SEAWEED FOR EMISSION CAPTURE: CULTIVATION

13.30 – 13.45	Scaling Sea lettuce in the ocean & into the food system, Simon Johansson, CEO, Nordic SeaFarm, Sweden.	#5
13.45– 14.00	Indoor cultivation and utilisation of seaweed in borehole seawater Arnar Þór Skúlason, PhD student, food Science, University of Iceland.	#6

SESSION 2: SEAWEED FOR EMISSION UTILISATION: BIOPLASTICS

14.00 – 14.15	AlgaePlast - a new bioplastic, Søren Krogsager, co-inventor and CEO of Scienciox A/S and Arianna Rech PhD student, DTU, Denmark	#7
14.15 - 14.30	Maddalen Ayala Upscaling the seaweed-based bioplastic from pilot- to industrial scale - An LCA perspective, phd, Aalborg University, Denmark.	#8
14.30 – 14.45	New sustainable way to create plastics from seaweed, Julia Marsch, CEO and co-founder of SWAY, California, USA. (Recorded talk).	#9

14.45 – 15.30 Coffee and cake

SESSION 3: SEAWEED FOR EMISSION UTILISATION: FOOD

15.30 – 15.45	Holistic sustainability in product development. Sofie Raae, Product developer, KOST , Denmark.	#10
15.45 – 16.00	Fermented seaweed for food applications Maren Sæther, SEAPRO project manager, MSc Biotechnology, Norway.	#11
16.00 –16.15	Plant-based seafood from seaweed and microalgae, Ditte Hermund, Food scientist, National Food Institute, DTU, Denmark.	#12
16.15 - 16.30	How does different precipitation strategies affect the final protein product and yield from Ulva sp?, Louise Juul, postdoc, Dept. of Food Science, Aarhus University, Denmark.	#13
16.30 – 16.45	Enviromental and nutritional performace of plant-based alternatives to meatballs, Maxime Ekoule, phd student, Dept. of Food science, Copenhagen University, Denmark.	#14
16.45 – 17.00	Climate positive value chains from gentle harvest and processing of sea lettuce – mission possible? Irsa Anwar, Dept .of Food science, University of Copenhagen, Denmark.	#15
17.00 – 17.15	Innovative Food Startup for Seaweed Products - Oceanfruit and BettaF!sh Miriam Goessmann, Ocean Fruit, Germany	#16

17.15 - 18.15 TASTE AND TALK – SEAWEED HAPPY HOUR– POSTER SESSION

19.00 - 23.00 Conference dinner at the Kattegatcentre, (Færgevej 4, 8500 Grenaa).
We meet at the hotel lobby at 19.00 and walk for 10 minutes to the Kattegatcentre.

PROGRAMME THURSDAY 12TH OCTOBER:

07.20 – 08.30 **Choose between two options: Sunrise with the penguins at the Kattegatcentre or company visit at PureAlgae. We leave from the lobby at 7.20.**
08.55 – 09.00 **Welcome back at the conference.**
Please, remember to check out no later than 10 o'clock.

SESSION 4: SEAWEED FOR EMISSION CAPTURE AND UTILISATION: ECOSYSTEM SERVICES

09.30 – 09.45 3 Phases Towards an Industrial Land-Based Seaweed Cultivation,
Esben R. Christiansen, biotechnology engineer Founder of Pure Algae, Denmark. #17

09.45 – 10.00 Does circular nutrient management imply increased sustainability of future Recirculation Aquaculture System? – a case study of the ValueFarm solution,
Cecilie Heide Nielsen, Dept. of Food Science, University of Copenhagen, Denmark #18

10.00 – 10.15 An eco-friendly nano-bio-fertilizer biosynthesized from seaweeds and test for its potential on seed germination and seedling growth of some vegetables including antibacterial activity.
Suparna Roy, Anna NCSCM, Anna University Campus, Chennai, Tamilnadu, India. #19

10.15 – 10.30 We need to improve our understanding regarding potential toxic elements in seaweed before we can succeed in expanding the seaweed industry in Europe.
Ingrid Olesen, Senior scientist, Department of Production Biology, Nofima, Norway #20

10.30 - 10.45 Open #21

10.45 – 11.15 **Coffee break**

SESSION 5: SEAWEED FOR EMISSION CAPTURE & UTILISATION: FEED

11.15 – 11.30 Inclusion of Bonnemaisonia hamifera in the diet of dairy cows reduces enteric methane missions
Mirka Thorsteinsson, Dept. of Animal and Veterinary Sciences, Aarhus University, Denmark #22

11.30 – 11.45 Seaweed extraction and fractionation as a strategy to identify bioactive compounds with methane mitigating potential.
Natalja P. Nørskov, Dept. of Animal and Veterinary Sciences, Aarhus University, Denmark #23

11.45 – 12.00 Potential anti-obesity impacts of Nordic macroalgae.
Prabhat Khanal, Faculty of Biosciences and Aquaculture of Nord University, Norway #24

12.00 – 13.00 **Lunch**

SESSION 6: SEAWEED FOR EMISSION UTILISATION: HEALTH & HIGH VALUE PRODUCTS

13.00 - 13.30 Keynote: Making protein Superfood from marine algae.
Wei Zhang, Finders University, Australia. #25

13.30 – 13.45 Brown seaweed against age-related macular degeneration? New insights into fucoidan based research – Inflammation and gene expression
Philipp Doerschmann, Research Unit of the Ophthalmology, University of Kiel, Germany #26

13.45 – 14.00 Effect of different purification methods on the stability of R-phycoerythrin from red seaweed, *Furcellaria lumbricalis.*
Sruthi Kumar,PhD student, Dept. of Food Science, Aarhus University, Denmark. #27

14.00 - 14.15 Seaweed for health, Susan Løvstad Holdt, DTU Food, Denmark #28

14.20 - 14.30 **Goodbye for now!**
14.30 – 15.00 **Coffee and cake.**

TWEET: #NSC22

ABSTRACT #1

SEAWEED BASED MARKET APPLICATIONS (SEAMARK): UNLOCKING THE POTENTIAL OF MACROALGAE FOR A THRIVING EUROPEAN BLUE BIOECONOMY

SeaMark is a four-year project that has been awarded a prestigious €9 million Horizon Europe grant to upscale seaweed production and market applications across Europe.

The consortium is led by Ocean Rainforest comprising 25 international, cross-disciplinary partners. SeaMark will utilise recent ground-breaking selective breeding technologies within EU seaweed crop genetics to increase biomass yield.

SeaMark aims to upscale circular ocean seaweed cultivation and land-based integrated multitrophic aquaculture (IMTA) systems and develops novel processing methods involving fermentation and biotransformation into twelve innovative seaweed-based products. The entire value chain will be analysed for techno-economic feasibility and socio-economic impact. SeaMark will also identify and quantify ecosystem services provided by seaweed cultivation. This will feed into a strategic development plan for upscaling seaweed production and addressing the carrying capacity of seaweed cultivation in Europe. Due to the need to build more resilient food systems and decrease reliance on fossil-based products, it is necessary to grow the blue bioeconomy through seaweed cultivation and product innovation.

SeaMark will help fulfil the United Nations Sustainable Development Goals by developing this industry and, simultaneously, providing a positive impact on people and the planet. The project commenced on July 1, 2022, and the presentation will focus on state-of-the-art, methods, and preliminary results.

SPEAKER

Urd Grandorf Bak
R&D manager at Ocean Rainforest, Faroe Islands

Urd has worked with research and innovation as the R&D manager at Ocean Rainforest since 2015. She is an expert in environmental biology and geography with a MSc from Roskilde University and she holds an Industrial PhD in offshore macroalgae cultivation which was a collaboration between the National Food Institute at DTU and Ocean Rainforest.

ABSTRACT #2

NORWEGIAN SEAWEED TECHNOLOGY CENTER

SPEAKER

Aleksander Handå
Senior Research Scientist SINTEF Ocean AS
Fisheries and New Biomarine Industry

Norway has the opportunity to develop the macroalgae cultivation to a new, large industry. Industrial cultivation of macroalgae gives opportunities for production of biomass that can be used as basis for many different products and that can contribute to make Norway more self-sufficient on food, feed ingredients and bioenergy. Norway has vast areas along the coast that are suitable for seaweed cultivation. Seaweeds are primary producers and can be cultivated in the sea without the use of arable land, fertilizers, fresh water, pesticides or antibiotics.

Norwegian Seaweed Technology Center is a knowledge platform for technology development within industrial cultivation, harvesting, processing and application of seaweed in Norway. The center of competence constitutes SINTEF Fisheries and Aquaculture, SINTEF Materials and Chemistry, NTNU Department of Biology and NTNU Department of Biotechnology. The center has a broad network of national and international collaboration partners and aims to support the Norwegian industry and public sector in enabling a new economy based on seaweed cultivation and processing.

ABSTRACT #3

THE FUTURE POTENTIALS OF NATURE-BASED SOLUTIONS IN MARINE MULTI-USE PLATFORMS

Low trophic aquaculture (LTA) can provide sustainable energy, nutritious seafood, and positive ecosystem services through emission (CO2 and nutrients) capture and utilization. Increased resources needs and marine space competition in Europe and globally encourage the integration of LTA in multi-use platforms. In this context, the potential for LTA to deliver significant benefits in offshore wind farms (OWF) was investigated via modelling for the North Sea-Baltic Sea transition zone, which is dominated by a strong salinity gradient.

The study showed that by allocating 10% of operating and planned OWF areas to sugar kelp and blue mussel aquaculture, 1039 kt-fresh weight, 12.0 kt-N, 0.73 kt-P and 49.3 kt-C could be removed yearly by harvesting, corresponding to 5% and 3% of the required N and P reductions, respectively, in the Baltic Sea Action Plan. The harvest potential was highest in the saline North Sea compared to the brackish Baltic Sea.

Overall, there could be a great potential to mitigate the eutrophication effects and produce blue biomass offshore with less user conflicts and a negative or low carbon footprint supporting the global sustainable development goals. In the coming four years, LTA will be tested at Kriegers Flak, Scandinavia's largest operating OWF and the production yields and effects on climate and marine environment of LTA will be documented as part of two new projects, OLAMUR and Win@Sea.

SPEAKER

Annette Bruhn
Ecoscience, Aarhus University, Denmark

Annette Bruhn (AB) works as senior researcher at the Department of Ecoscience at Aarhus University, Denmark. Her research focus is cultivation of macroalgae as a bio-resource and a nature-based solution for mitigating eutrophication and climate change. AB works in the cross field between biological oceanography and macroalgae ecophysiology, and always in transdisciplinary teams in cooperation with authorities and industry/SMEs. AB is co-founder of AlgaeCenter Denmark and Nordic Seaweed Conference.

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5. Green Solution Center (GSC), University of Copenhagen, Denmark
6. Marine Aquaculture, Shelf Sea Systems Ecology, Biosciences, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI), Germany
7. Applied Marine Biology & Aquaculture, University of Applied Sciences Bremerhaven, Bremerhaven, Germany
8. Vattenfall, Denmark, Environment and Sustainability Unit (EnSU), Vattenfall Vindkraft, Kolding, Denmark
9. The Kattegatcentre,Denmark

ABSTRACT #4

MACROALGAE AS A SOLUTION FOR DEVELOPING A SUSTAINABLE, CARBONNEUTRAL AND CIRCULAR BLUE ECONOMY

SPEAKER

Efthalia Ervarti
Programme manager of SUBMARINER Network for blue Growth EEIG, Germany.

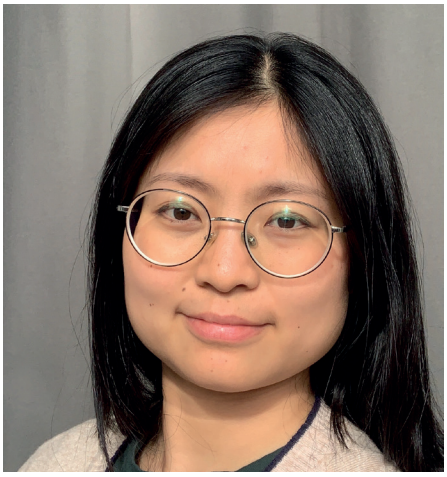
Efthalia promotes blue/green bioeconomy, supports innovation, technology and knowledge transfer as well as building innovation ecosystems.
Her expertise lies in blue bioeconomy sectors, such as blue biotech, algae and shellfish farming topics and also processing and product development, where she creates synergies and linkages, and matches people and ideas.

Algae have an important role to play in the implementation of "Mission Ocean and Waters 2030", that aims to protect and restore marine and freshwater ecosystems and biodiversity, will prevent and eliminate pollution of our ocean, seas and waters, and make the sustainable blue economy carbon-neutral and circular. According to the recommendations of SUBMARINER Roadmap 2021-2027 that consolidated results from 15+ transnational algae projects, and also the conclusions from the public consultation "Towards a strong and sustainable EU algae sector" , there is solid evidence that algae and seaweeds can provide for food, biobased and nature-based solutions at scale both at EU and specifically in the Baltic and North Sea area.
Following these evidence, the new round of SUBMARINER seaweed projects, such as the Seamark (HEU), BalticSeaSafe (SSC) and BlueMissionBANOS (Mission Ocean), UNITED (H2020), and EU4Algae (DG MARE) aim at demonstrating algae value chains and supporting development of new markets, while also securing the sustainability, circularity and carbon-neutrality of algae at scale.

Context
Mission Ocean "Restore our Ocean and Waters by 2030" will help to protect and restore marine and freshwater ecosystems and biodiversity, will prevent and eliminate pollution of our ocean, seas and waters, and make the sustainable blue economy carbon-neutral and circular.
To support implementation of the Mission Ocean, four regional "lighthouses" are being built supported by an EU charter and EU funding opportunities in collaboration with member states. Lighthouses are acting as innovation hubs, each tasked with own targets and themes, and the lighthouse for Baltic and North Sea area is focusing on developing a sustainable, carbon-neutral and circular blue economy.

ABSTRACT #5

VEGAN BACON MADE FROM SEAWEED



SPEAKER

Aimai Wang
IFF - International flavours and fragrances Denmark

Working on product development of Meat Alternatives at IFF since Jan 2020
Background in Food Science, Nutrition and Engineering
Ph.D. in Food Science from Aarhus University 2018

The texture of meat alternative comes primarily from hydrocolloids and functional plant proteins. Non-animal ingredients such as methyl cellulose and carrageenan are widely used in meat alternatives for their ability to provide the hot texture and cold texture, correspondingly.

However, there is a trend to avoid methyl cellulose in meat alternative products. Egg white possess excellent gelling properties, but it is not suitable for vegan products. Seaweed is one of the largest resources on earth. Alginate from red seaweed has been used in meat products for its excellent gelling properties together with sulphates. However, sulphates are not legally allowed in the meat alternative products in certain regions.

Inspired by the meat processing method, a new solution for both hot and cold texture in meat alternatives based on vegetable proteins and alginate was invented. It creates a homogenous gel with or without heating, which can be processed further into different shapes. The solution is versatile and can be used in many different types of meat alternative products such as burgers, nuggets, bacon, cold cuts, sausages, lardon, solid fat, steaks, schnitzels, and so on.

ABSTRACT #6

SEAWEED ACTIVITIES AT THE MOKPO MARINE FOOD RESEARCH CENTER IN JEOLLANAM-DO, SOUTH KOREA

SPEAKER

Dr. Young Chul Lee
The Center Director,
Mokpo Marine Food Research Center,
Korea

Mr. Youngchul, Lee, pH.D, Korean National food engineer and Director of Mokpo marine food industry cente has been working for over 30 years in all value chains of food industry. Recently, he is working as committee member of Jeollanam-do marine fisheries start-up investment support center in Ministry of Maritime Affairs and Fisheries. Also he is working as professional consultant and lecturer of agricultural & marine food processing division, Korea Institute of Human Resources Development (KIRD) in Ministry of Science and Technology in South Korea.

South Korea is one of the world largest seaweed production countries. Especially, Jeollanam-do is the largest seaweed production area in South Korea and Mokpo marine food industry research center is located in Jeollanam-do as hub.
Regarding bio-health and pharma division, Mokpo marine food industry center performed bio-active materials screening from many kinds of potential seaweed candidates and found an anti-oxidant, anti-inflammatory, anti-fat and anti-atopic activity.

Regarding food innovation, Mokpo marine food industry center developed high quality and applied marine foods like seaweed snack, seaweed fish cake and home meal replacement. Quality standardization and safety from raw material to marine food product are evaluated by Mokpo marine food industry center which was registered official analysis center by Korean FDA.

Hereafter, Mokpo marine food industry center will greatly contribute to local economy activation and industry development of K-seafood by conducting major projects regarding high quality marine food product R&D and business incubation successfully.

ABSTRACT #7

BIOREFINERY OF *ULVA* SPP. AND EVALUATION OF FOOD QUALITY OF RESULTING PROTEIN CONCENTRATE

Sea lettuce (*Ulva spp.*) harvested in a Danish Fjord was processed in lab and pilot scale. The main goal was to extract protein from the biomass and evaluate it according to yield and food quality. The biomass crude protein content ranged between 6 and 20% of dry matter, concentrating up to 4- and 6 -fold upon processing with double screw pressing followed by acid precipitation and centrifugation in pilot scale and lab scale, respectively.

Depending on season, the protein concentrate showed between 40 and 50% crude protein of dry matter. Washing of the biomass before processing lowered the ash content in the protein concentrates. The protein concentrates from the pilot study were evaluated in relation to functional properties. Solubility, foaming and gelling of *Ulva* protein fractions and pea protein isolate (PPI) were investigated at food relevant pH conditions and a salt concentration of 0.2 M NaCl. Solubility of all protein fractions was low (< 20%) but alkaline pH-shift increased the solubility significantly. In general, the foam stability increased for PPI and *Ulva* fractions after alkaline pH-shift. Gelling properties of *Ulva* protein were assessed at 10% and 30% relative substitutions in 20% PPI gels revealing a synergistic effect between *Ulva* protein concentrate and PPI on gel texture. Even though the Ulva protein concentrate show promising results, the processing needs further improvement before utilising the biomass for food.

SPEAKER

Trine Kastrup Dalsgaard
Department of Food Science,
Aarhus University, Denmark

Trine Kastrup Dalsgaard is Cand Polyt. in biotechnology from Aalborg University and has a PhD in Food Chemistry and Technology from Aarhus University.

During the last ten years her focus has been on alternative protein for food. She has focused in biorefinery of green biomass from land and sea within bio circular perspective with valorization and evaluation of all components in each biomass.

AUTHORS

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ABSTRACT #8

A SENSE OF SEAWEED

SPEAKER

Madeleine Jönsson
PhD student, Faculty of Engineering,
Lund University, Sweden

Madeleine Jönsson is a Ph.D. student in biotechnology at Lund University, Faculty of Engineering, with a special interest in sustainability, biomass conversion, and communication. During the first three years of the Ph.D. course, her research has been linked to the interdisciplinary project Marine Food Resources for New Markets. Here challenges such as post-harvest treatment, food safety, and consumer attitudes, associated with an emerging seaweed market, have been in focus. In 2022, Madeleine's curiosity for an established seaweed culture brought her to Nagasaki, Japan, to put herself at the intersection of the perspectives of an emerging and established seaweed market.

"Yuk, disgusting!" or "it is a food of the future!" – opinions on seaweed for food consumption are many and can be seen as a fascinating contradiction between disgust and wonder. But what do people actually think seaweed taste like? In our study, we explore the sensory properties of four different seaweed species (SL:Saccharina latissima, AE:Alaria esculenta, PP:Palmaria palmata, and Ulva sp.) commonly found in northern Europe, and aim to link that to these sea vegetables' biochemical and physicochemical properties.

The four species differed significantly in flavor, appearance, odor, and texture. Panelists considered SL to have a lighter color and more yellow features than other species. Both SL and AE were perceived to have higher crispiness and lower curliness in the comparison. Additionally, AE was considered the darkest, greenest of all species, with the lowest elements of saltiness, fish liver oil, and sea odor. PP distinguished itself by its dark magenta color, with the least element of yellow and green. It had an enhanced flavor of umami and fish liver oil, and an odor of shellfish (dried shell). Additionally, the texture was perceived as the chewiest and hardest. Finally, Ulva was perceived as the saltiest species. It had an odor resembling lemon and fresh grass. Panelists perceived Ulva as more curly than other species and with a lightness in color with elements of yellow. The texture was the least crispy but was neither perceived as hard nor chewy. These results can be directly useful in the development of new food applications.

ABSTRACT #9

SHORT PITCH: GLOBAL GREEN CHALLENGES, LOCAL STRENGTHS AND ANSWERS, INTERNATIONAL COLLABORATION FOR NEW SOLUTIONS

SPEAKER

Ditte Rønde Veise
Executive Director,
Innovation Centre Denmark,
South Korea.

Innovation Centre Denmark is located in the world's hotspots for innovation including South Korea. In this presentation we will give examples on how Denmark and South Korea are collaborating on green transition, health and ICT/technology. What are the strongholds in Korea in the field of seaweed production and use, and how can that knowledge be transferred to elevate Danish R&D in support of sustainable growth and development goals? We will indicate what are the opportunities for different stakeholders in the innovation ecosystem, including universities and companies to work with the Danish Innovation Center.

ABSTRACT #10

SHORT PITCH: NEW BIOREFINERY TEST FACILITIES FOR BLUE BIOMASS

SPEAKER

Thorkild Frandsen

Leader of Bioresources-team at Food & Bio Cluster Denmark, Denmark.

Thorkild Qvist Frandsen is leader of the bioresource team in Food & Bio Cluster Denmark. During the last 15 years he has worked to accelerate innovation in companies working with sustainable production and utilization of bioresources including aquatic biomass. Thorkild has been involved in a wide range of research, development and demonstration projects involving small, medium, and large private enterprises together with universities and research and technology organisations. He has previously worked with technologies for transition to the circular bioeconomy in both Danish Technological Institute and in AgroTech.

Lack of available biorefinery facilities is often mentioned as a barrier for development, test, and demonstration of new seaweed-based products and product components. To overcome this barrier the Biosolutions Zealand-project now invests in a number of open access biorefinery and fermentation technologies ranging from small scale equipment for use in laboratories to a large-scale demonstration plant. By establishing these facilities and making them available for both research institutions and private companies the intention is to boost development of biobased products and technologies for processing different types of bioresources including seaweed. The new biorefinery and fermentation facilities can be a big step forward to develop seaweed process technologies for effective extraction of high value components for food and feed applications as well as components for cosmetics and materials. Behind Biosolutions Zealand is a consortium counting Danish Technological Institute, Technical University of Denmark, Copenhagen University, Aarhus University, Roskilde University, Food & Bio Cluster Denmark, and a number of private companies as well as municipalities and other public actors.

ABSTRACT #11

VOLTA GREENTECH - LOWERING METHANE EMISSIONS FROM CATTLE WITH SEAWEED

SPEAKER

Angelo Demeter
Volta Greentech AB,
Sweden

Angelo comes from Transylvania, Romania where he got a B.Sc in Biotech Engineering in Food industry. He's been living in Sweden for the past 6 years where he completed a M.Sc in Molecular Biology and worked with cancer cell metabolism.
3.5 years ago he met Fredrik, his co-founder and together they started Volta Greentech, with the mission to feed seaweed to all the cows in the world.

Volta Greentech is on a mission to feed all the cows in the world with red seaweed. A special type of red seaweed called Asparagopsis,which when the cows are eating, in as low as 0.6% of their daily feed, it reduces their enteric methane emissions by up to 90%.

Over the past 3.5 years Volta has attracted over 5M€ in funding and a team of 14 full-time employees out of which 80% are scientists and engineers.
We are currently developing the blueprint for large-scale land based cultivation of Asparagopsis in a pilot factory on the West coast of Sweden and will soon build the first true large scale seaweed factory in the world. Furthermore, we're continuously researching how to increase the efficiency of these systems and the quality of our seaweed in our R&D Lab in Stockholm.

We have also performed two commercial pilots on two different farms in Sweden and achieved >80% and >90% methane reduction respectively. The latest trial completed this year in June resulted in the first low methane beef in the world, and a new brand - LOME, which was sold in 20 Coop stores in Sweden. Read more at www.voltagreentech.com

ABSTRACT #12

PHLOROTANNIN RICH SUPPLEMENTS FOR PIG FEEDS

SPEAKER

Pamela Judith Walsh
Senior lecturer,
Queen´s University Belfast, UK

I am a senior lecturer in the School of Mechanical Engineering at QUB and an RAEng/ Leverhulme Trust Senior Research Fellow. My research group's work focuses on the development and functionalisation of marine materials, mainly seaweeds and microalgae for pharmaceutical, biotechnological and biomedical applications. One of our current project is a DAFM/DAERA funded project (1.2 million) which is focusing on seaweed supplements as a replacement for zinc in pig feed diets.

Our research investigates the potential of using phlorotannin (phenolic compounds specific to brown seaweed) rich seaweed supplements in pig feed to improve its nutritional value using sustainable seaweed feedstocks.

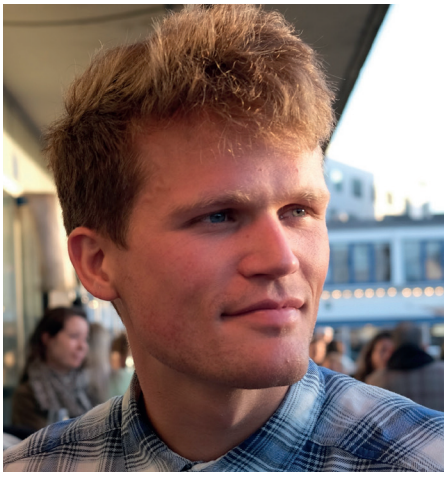
The aim of the work is to develop seaweed supplements to improve the gut health of the animals. High concentrations of phlorotannins from seaweeds can bind to the proteins in the food and result in lower digestibility. This is not a desirable outcome for meat producers. Our work looks at the delicate balance between improved gut health without impacting digestibility. Another factor to consider is also the biochemical profiles of the phlorotannins that will be used. Seasonality in seaweeds is known to change their chemical profiles, therefore, it is important to understand these changes and their impact on animal feeds.

Chemical compounds in seaweeds particularly prone to seasonal change are the phlorotannins. These chemicals have important health benefits for both the animal's nutrition and, in turn, the quality of the meat supplied to humans. Our work tests the seaweed supplemented pig fed in vitro, to assess the seasonal effects on the digestibility of seaweed supplemented animal feeds. This will give some clarity on the health benefits and potential of replacing the deficit feed with seaweed. 20% of animal feeds used in pig farming in Northern Ireland are sourced from outside of Europe.

Sustainable practices utilising seaweed as a crop, could help to bridge the gap between the supply chain and the demands placed on the agri-food industry.

ABSTRACT #13

NON-DESTRUCTIVE MAPPING AND SUSTAINABLE HARVEST METHODS OF *FUCUS VESICULOSUS* BEDS



SPEAKER

Jørgen U.G. Levinsen,
PhD student, Ecoscience
Aarhus University, Denmark

Jørgen Ulrik Graudal Levinsen, PhD Student at Aarhus University, department of Ecoscience, Section for Coastal Ecology. I work with cultivation of novel species of macroalgae with methane reduction potential in ruminants as a part of the Climate Feed project.

The growing interest in commercial uses of the brown macroalgae *Fucus vesiculosus*, a vital keystone species and ecosystem engineer in the intertidal zone, raises the issue of supply and demand. Supply is limited as wild harvest remains the primary source of *F. vesiculosus* biomass, due to undeveloped cultivation practices. Despite the essential role of *Fucus* beds for coastal ecosystem services and the amplifying stressors of eutrophication, climate change and harvest our knowledge on the effects of harvesting *F. vesiculosus* at scales from individuals to ecosystems is scarce and few harvest regulations exist. This study aims is to give an outline of "best practice" for harvest of *Fucus* beds in Denmark, focusing on recovery potential, impact degree and biomass quality.

Fucus recovery potential was examined over a period of more than a year in two locations, Knebel Vig and Isefjorden, at an individual scale and a population scale, that included the use of drone footage. Two different harvest methods were applied: a gentle (tips) and a more invasive (full), using the Before-After-Control-Impact design. Biomass-composition analysis was performed with a focus on undesired substances.

Results show a clear difference in the recovery potential between harvest methods at the individual scale. However, the population scale harvest and biomass analysis results are less clear. Finally, drone footage could provide a valuable tool for non-destructive mapping of *Fucus* beds.

The process of interpreting whether the combined results can point toward a "best practice" for harvesting *Fucus* beds in Denmark is ongoing.

AUTHORS

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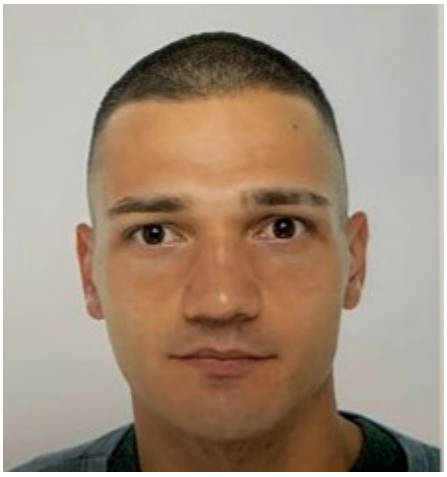
#14

UMAMI-RICH FOODS AS MEDIUM TO IMPROVE THE NUTRITIONAL PROFILE AND LIFE CYCLE ASSESSMENT OF PLANT-BASED SPREADS



SPEAKERS

Andrea Gobbato and Minaka Ono
Master of Science student,
University of Copenhagen, Denmark.

Imagine a world, where it is possible to have a stable production of high-quality seaweed in the Northern hemisphere all year round without having to depend on weather. Now it is possible, with the capture-based production technology developed by Pure Algae.

Based on several years of research, the passion of a Danish engineer, and a close collaboration with Aarhus University, the biotech company Pure Algae has laid the foundation for a sustainable and profitable land-based cultivation of seaweed.

Pure Algae's cultivation systems are built within recycled 40-foot containers. The controlled environment ensures a high-efficient, stable production of high-quality seaweed so clean and free from allergens and heavy metals, that it can be utilized by the pharmaceutical industry among other. A quality, that is in high demand and can be sold at very attractive kg prices.

The capture-based technology is developed with great concern for the environment, as it turns emissions into revenue streams by transforming nitrogen compounds and CO_2 from process water of land-based fish farms into a valuable biomass in the form of seaweed. The land-based technology thereby not only produces seaweed in an efficient and sustainable manner, but in large scale also supports the land-based fish farm to meet the regulations on discharged processed water.

POSTERS

USING QUANTITATIVE STORYTELLING TO IDENTIFY CONSTRAINTS IN RESOURCE SUPPLY: THE CASE OF BROWN SEAWEED FOR BIO-BASED PLASTICS

Maddalen Ayala

Maddalen Ayala is a PhD candidate at Aalborg University working on Life Cycle Assessment of emerging technologies for the Blue Bioeconomy, with a focus on brown-seaweed-based plastic production. She assesses this emerging technology from an ex-ante consequential life cycle assessment perspective. In her PhD, she studies the global suppliers of brown seaweed that are expected to increase in the future, the entire life cycle assessment of the seaweed-based plastic and the upscaling of this technology.

Seaweed is gaining interest in different sectors. It's a promising resource due to its environmental benefits and multiple applications. Bioplastic is one of the novel applications and, therefore, an emerging technology. Considering the increase in the number of potential new applications of seaweed biomass, it is relevant to understand what would be the impacts associated with a corresponding increase in demand and supply of seaweed. In the field of consequential life cycle assessment (LCA), this is referred to as identifying marginal suppliers, intended as understanding which suppliers are free of constraints to increase their supply of products to the market. Current methods to identify marginal suppliers are based on quantitative information and do not consider uncertainties that exist for emerging technologies, such as. In this research, we propose the use of Quantitative Story-Telling (QST), a 5 step procedure using a combination of interviews and data analysis, to identify marginal suppliers of brown seaweed. The findings indicate that there are two primary groups of countries that, for various reasons, are expected to be the marginal suppliers of brown seaweed: China, Japan and Korea are currently the primary providers, and are anticipated to continue growing and being marginal suppliers in the future. Seaweed aquaculture has a well-established market in those Asian countries. On the other hand, Northern Europe and North America are still developing as brown seaweed suppliers and are expected to expand more quickly in the future, due to technological development, production capacity and increasing interest in seaweed from different industries.job opportunity.

VALSAR - VALORIZATION OF "SARGAÇO", WASHED ASHORE SEAWEEDS

Bárbara Costa Camarão

Abusaid,A. 1 , Camarão,B. 2 , Resende, L. 2 , Cotas, J. 2 , Pereira,L. 2 , Pereira,C. 3 , Rosete, M. 3 , Bahcevandziev,K. 4 , Rocha,A. Cristina 2. 1 Department Environment Engineer and Energy-INSA, Lyon, France

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"Sargaço" is a mixture of seaweeds that grow on the rocks of northern Portuguese coast and that are washed ashore on the beach. Traditionally, "sargaço" was collected by local farmers and fishermen, dried and applied in agriculture or sold fresh for industry. Nowadays, the traditional collection of "sargaço" has fallen into disuse. Nevertheless, seaweeds continue to wash ashore on the beach and, in summer period, they are considered a problem for coastal municipalities. On the other hand, this natural biomass, rich in minerals and several metabolites, is wasted and under- exploited. VALSAR – Valorisation of Sargaço from northern Portuguese coast is a project that aims to investigate and exploit the potential of these washed ashore macroalgae and valorise this natural biomass, contributing for the local economic development of coastal municipalities. For that, a multidisciplinary team is currently working on:

-the production of a seaweed-based biostimulant;

-the production of a biofertilizer based on a mixture of seaweed and organic waste;

-the identification of pharmaceutical and cosmetic properties of seaweed-based extracts. Experimental assays are being conducted but interesting results have already been attained. One is eager to share more information about the project and our work, as well as some of our recent findings.

POSTERS

ENTERIC METHANE EMISSION FROM DAIRY COWS FED THREE BROWN SEAWEED SPECIES

Mirka Thorsteinsson

Mirka Thorsteinsson started her Ph.D. at the Department of Animal and Veterinary Sciences, Aarhus University in the spring of 2020. The aim of her Ph.D. is to find feed additives, including macroalgae, that can reduce methane emissions from dairy cows.

Seaweeds procured from the Northern hemisphere have shown potential to reduce in vitro methane production. This study aimed to investigate in vivo effects of three brown seaweeds (Phaeophyceae) on enteric methane emission, feed intake, digestibility of nutrients, and milk yield from dairy cows. The experiment was conducted as a 4 × 4 Latin square design using four lactating Danish Holstein dairy cows. Seaweed products were dried and ground prior to mixing into the experimental rations. The cows were fed a ration without any seaweed or the same ration diluted with, on a dry matter-basis, either 4% ensiled Saccharina latissima, 4% Ascophyllum nodosum, or 2% Sargassum muticum, for periods of 21 d consisting of 14 d of adaption, 3 d of digesta sampling, and 4 d of gas exchange measurements using respiration chambers. Dry matter intake (DMI) and milk yield were recorded. Digestibility of nutrients was investigated using two external markers. None of the three seaweeds affected methane emission expressed as g/d or as g/kg DMI (P-value 0.14 and 0.74, respectively). Moreover, milk yield and DMI were unaffected by dietary inclusion of seaweeds (P-value 0.51 and 0.34, respectively). Inclusion of the seaweeds did not affect the apparent total tract digestibility of dry matter, organic matter, neutral detergent fiber, or crude protein compared to control diet. In conclusion, the inclusion of A. nodosum, S. muticum, or ensiled S. latissima in the feed ration of dairy cows had no impact on neither cow productivity nor methane emission compared to the control diet.

FUCOIDANASE FIM28 FROM ICELANDIC HOT VALVES

Signe Vangsgaard

Signe Vangsgaard is studying for her M.Sc. in Biotechnology at the Technical University of Denmark, where she is currently writing her master's thesis. She received a B.Sc. in Biotechnology from the Technical University of Denmark in 2020. Her interests include synthetic biology, microbiology, and enzymatic characterizations Authors: Signe Vangsgaard, Maria D. Mikkelsen, Björn Þór Aðalsteinsson, Guðmundur Óli Hreggviðsson, Anne S. Meyer.

Fucoidans from brown macroalgae are complex sulfated fucosyl-polysaccharides [1]. Different types of macroalgae produce different backbone structures often resulting in different bioactivities [2]. Fucoidans originating from Saccharina latissima produce galactose-containing fucoidans, called galactofucans, where the fucosyl backbone are α-(1,3) linked [1]. S. latissima is of special interest, as it is culturable in the Northern hemisphere [1].

The bioactivities exhibited from fucoidans include anticancer, anticoagulant and anti-inflammatory abilities [2]. In order to exploit these bioactivities in biomedicine, a homogeneous fucoidan digest is required. Traditional methods of depolymerizing fucoidan, such as acid treatment, yields fucoidan digests of high heterogeneity. For that reason, an alternative method is required. Fucoidanases are enzymes capable of depolymerizing the complex fucoidan polymers in a controlled manner, resulting in homogenous fucoidan oligosaccharides. Not many fucoidanases have been characterized as of yet, and only one of the characterized fucoidanases exhibit activity towards the fucoidan from S. latissima [1].

Being a part of the BlueBio project MARIKAT, the aim of this study is to characterize robust fucoidanases, which can be utilized industrially [3]. The fucoidanase from this study is fucoidanase Fim28. Fim28 stems from a metagenome isolated from Icelandic hot valves and belongs to the glycoside hydrolase family GH107. Fim28 is able to digest the fucoidan purified from S. latissima, producing low molecular weight fucoidan oligosaccharides. Currently, Fim28 is being characterized in regards of different optima, salt requirements and fucoidan digests.

POSTERS

ACTIVE PHAEOVIRUS INFECTIONS IN BROWN ALGAE OF THE BAY OF KIEL (BALTIC SEA) INDICATED BY TRANSCRIPTOME RESPONSE

Timo Jensen

Author list: Timo Jensen*, Dominik Bents, Mira Wilkens, Yu-Chen Wu, Rafael Meichßner, Steffen Hennig, Sven Petersen *presenting authors
Timo Jensen (M. Sc. Biotechnology) is PhD student at Coastal Research & Management, working enzymes from marine algae. This work includes transcriptomics, proteomics, bioactivity assays, and recombinant expression of proteins.

Background: Recently, molecular and morphological evidence for phaeovirus infections was found in commercially important kelp species (Laminariales). On the molecular level, the phaeovirus-encoded major capsid protein (MCP) gene was targeted by DNA extraction and standard PCR methodology. In this study, we use transcriptome analysis after RNA extraction to examine for active infections in Brown Algae of the Bay of Kiel. Methods: Specimens of Saccharina latissima (n=2), Chorda filum, Fucus vesiculosus, Fucus serratus, Ahnfeltia plicata, Ceramium virgatum, Phyllophora crispa, Furcellaria lumbricalis, and Bryopsis plumosa were sampled in the Bay of Kiel. After RNA extraction, sequencing, and de novo contig assembly, the generated transcriptome database (RNA-Seq) was blasted for known Phaeovirus MCP sequences (KY063706-KY063723, HG003317-HG003355, LdigPH10-30 m: KY316507). Results: We found homologies to known phaeovirus MCP sequences in the transcriptome data from F. vesiculosus, C. filum and in one sampled specimen of S. latissima. Homologous sequences shared an identity ranging from 82.9 to 92.2%, indicating the expression of proteins highly similar to known phaeovirus MCPs. No indications for phaeoviruses were observed in the other specimen of S. latissima, F. serratus, or any of the tested red and green algae species. Conclusions: Active phaeovirus infection, as indicated by transcriptome analysis, was a common occurrence in Brown Algae sampled in the Bay of Kiel. Ecological and possible commercial implications regarding aquaculture remain to be investigated.

FERMENTED SEAWEED AS FOOD INGREDIENT

Erik Dahm

Microbiologist, Quality and project manager at ISI Food Protection, Aarhus Denmark. Veterinarian and former Head of the laboratories at the Danish Veterinary and Food Administration.

An innovation project with participants from Seaweed Solution A/S Norway, ISI Food Protection Denmark, Aventure AB Sveden, Copenhagen and Lund Universitees. Goal of the project: Develop fermented seaweed as a new food ingredient/raw material for use in food, functional foods and nutraceuticals. Develop the right bacteria strains and processing conditions for seaweed fermentation. Evaluate sensorial and functional properties in actual food application (e.g. plant-based burgers) . Evaluate food safety aspects and nutritional benefits.

POSTERS

EXTRACTION AND EVALUATION OF SEA LETTUCE PROTEIN
Louise Juul, Aarhus University, Department of Food Science, Denmark.

NON-DESTRUCTIVE MAPPING AND SUSTAINABLE HARVEST METHODS OF *FUCUS* BEDS
Mette Møller Nielsen, Peter Søndergaard Schmedes & Aris Thomasberger, Technical University of Denmark (DTU), Section for Coastal Ecology, Denmark.

METABOLITES OF SEAWEED IN THE BATTLE AGAINST CLIMATE CHANGE
Theresa Otten, Marco Battelli, Mihai Victor Curtasu, Annette Bruhn, Mette Olaf Nielsen & Natalja Nørskov, Ecoscience?, Aarhus University, Denmark.

SEDIMENTATION AND LABILITY OF *SACCHARINA LATISSIMA* DERIVED POM IN A LARGE-SCALE SEAWEED FARM
Sidsel Juul Vinbæk, Signe Høgslund, Birgit Olesen & Annette Bruhn, Ecoscience, Aarhus University, Denmark.

SEAWEED ACTIVITIES AT THE MOKPO MARINE FOOD RESEARCH CENTRE
Dr. Dooryong Kim, Mokpo Marine Food Research Center, South Korea

CAN SEAWEED CULTIVATION CONTRIBUTE TO MARINE CARBON SEQUESTRATION?
DISSOLVED ORGANIC MATTER RELEASE AND DEGRADATION BY SUGAR KELP, *SACCHARINA LATISSIMA*.
Sidsel Gurholt Pedersen, Freja Skødeberg Christiansen, Teis Boderskov, Johnna Michelle Holding, Birgit Olesen & Annette Bruhn, Ecoscienc, Aarhus University, Denmark.

GROWTH AND REPRODUCTION IN MULTI-ANNUAL DELAYED GAMETOPHYTES OF *SACCHARINA LATISSIMA*
Anna Sauermilch, Teis Boderskov, Birgit Olesen and Annette Bruhn, Ecoscience, Aarhus University, Denmark.

ENCHYTRAEIDS AS LIVE FEED FOR AQUACULTURE – DEVELOPMENT OF MASS PRODUCTION AND CRYOPRESERVATION
Matthias Engell Dahl Holmstrup. Aarhus University & Fishlab, Denmark.

TASTE-SEA – SEA-VEGETABLES WITH ENHANCED FLAVOR FOR FUTURE SUSTAINABLE FOODS
Evangelina Zioga, Evangelia Zioga, Claus Heiner Bang-Berthelsen, Susan Løvstad Holdt, Fredrik Gröndahl, Department of Sustainable Development, Environmental Science and Engineering, ABE, School of Architecture and the Built Environment, KTH, Royal Institute of Technology, Stockholm, Sweden, National Food Institute, Technical University of Denmark, Kgs. Lyngby, Denmark.

SEASONAL AND LOCATIONAL VARIATIONS OF PROTEIN AND POTENTIAL TOXIC ELEMENTS OF *FURCELLARIA* IN DENMARK
David J. Jensen[1], Florian Brulfert[1], Jens J. Sloth1, Johan Nielsen[2], Mikkel K. Villadsen[2], Peter K.K. Petersen[2], Ole Hertz, Hans Porse, Susan L. Holdt[1]
1The National Food Institute, Technical University of Denmark (DTU Food), 2Aquamind, Denmark.

INCUSEA FEED. *ASPARAGOPSIS*: METHANE INHIBITING CATTLE FEED ADDITIVE
Peter Søndergaard Schmedes, Hugo d'Auriol, Damien Balkin, DTU Aqua, Danish Shellfish Centre and Maripure, Denmark.

ABSTRACT #15

3D PRINTING BIOPLASTICS

SPEAKER

Henrik Truelsen
Electronic engineer at Tricon, Denmark

I am making hard bioplastics, textiles and thin soft bendable bioplastic, from mainly red algae polymers. I have tried different kinds, with dansktang.dk. selectively testing, and picking kinds with fast, and easy growth potential. The bioplastic, besides these polymers, contains less than 1% of other organic substances added.

The creation of this bioplastic, depends on a hardening step in the production, where dehydration is a necessary step. This dehydration causes some deformations, making traditional production equipment like injection molding, or extruding unsuitable for production. I have created some experiments, where I instead 3D printed this material (rebuilding a traditional 3D printer a lot, to be able to pump this algae). Using this new technique, is currently showing some promising results.

My presentation will therefore contain, explanation of the challenges mentioned above, videos of the printer printing (some printed models, the ordinands can feel and touch after the presentation) Besides this information, I will present thoughts, on how harvesting can be done best, and what recourses could be interesting to selectively pick (for instance, fibers to create textiles, or anti-flammability additions like hemp or eelgrass, or even microalgae) I will also bring models, containing mixtures of the red algae polymer, and other material additions, along with me.

My name is Henrik Truelsen, I am an electronic engineer. I am 30 years old, I live in Linå, Silkeborg with my girlfriend, her 2 kids, and our son. I am working with production, mainly creating embedded software, hardware, and mechanical designs. I am frustrated, that most sources used, are polluting, and often requires production far away. My motivation in creating this bioplastic, (and underlaying production routine) is therefore based on doing something great for the environment. While also a wish to distribute production, using positively impacting local resources, instead of so much global production, gathered in only one country.

ABSTRACT #16

CULTIVATED SEAWEED FOR PACKAGING AND OTHER BIOMATERIALS

ONLINE TALK

SPEAKER

Øystein Arlov
Senior Scientist,
Industrial and Marine Biotechnology,
Norway

As plastic pollution and over-exploitation of non-sustainable natural resources causes global environmental issues, there is now more than ever a great need for new sustainable bio-based materials for packaging and other applications. The 'PlastiSea' project has studied the potential of utilising cultivated brown algae for new bioplastic materials, assessing novel biomass processing techniques, and the technical competitiveness, scalability, and economic and environmental viability of the materials.usiness case and, as a result, harvest 1,000 tons of seaweed.

Øystein Arlov is a Senior Scientist representing the Industrial and Marine Biotechnology research group at SINTEF Industry in Norway, and is the coordinator of the ERA-BlueBio project 'PlastiSea'. Øystein holds a Ph.D. from the Norwegian University of Science and Technology (NTNU) in functionalized alginates for tissue engineering, and his current research interest and activities are mainly within biorefinery of seaweed biomass and the structural functional characterisation and use of seaweed-based polysaccharides in biomaterials and other applications.establishing the first large-scale and multi-use seaweed farm in an offshore wind farm.

ABSTRACT #17

LIFE CYCLE ASSESSMENT OF PILOT-SCALE PRODUCTION OF SEAWEED-BASED PLASTIC

SPEAKER

Massimo Pizzol
Professor,
Dept. of Planning, Aalborg University, Denmark

Massimo Pizzol is a professor at Aalborg University, more specifically at the Danish Centre for Environmental Assessment (DCEA). He is an expert in the domain of Industrial Ecology and Sustainability Science specialized in Life Cycle Assessment (LCA), with skills in quantitative, qualitative and mixed research methods and a focus on interdisciplinary enquiry.

Plastics represent an environmental challenge and it has increasingly become a topic of interest in recent years. Biodegradable bioplastics are presented as a solution to reduce plastic pollution and the manufacture of bioplastic using seaweed is getting popular in the last years.

However, it is still unclear how producing this new bioplastic may impact the environment. In this study, we use primary data on a pilot-scale alginate-based plastic production to assess the environmental impacts using consequential life cycle assessment (LCA). In the LCA we include the carbon uptake in the seaweed cultivation, biorefinery for alginate extraction, a crosslinking step to produce the bioplastic and two end-of-life scenarios: incineration and composting. The main hotspot in the production of bioplastic is glycerine in the crosslinking step. To this end, we assess different scenarios of cascade utilisation by recirculating the mannitol and cellulose fractions of the seaweed in the biorefinery to replace fossil-based components in the crosslinking process step.

The research is complemented with a carbon balance and uncertainty analysis. The impacts in the scenarios where mannitol and cellulose are recirculated are significantly lower. The preliminary results show that this bioplastic has a global warming potential (GWP) of 3.5 kg CO_2 eq., lower than other bioplastics such as polylactic acid (PLA).

#18

PHD PITCHES

BLUE BIOREFINERY:GREEN AND SUSTAINABLE VALORISATION OF GRACILARIA GRACILIS.
Deborah Maria Racca, STAR*Facility Centre, Department of Agriculture, Food, Natural Resources and Engineering (DAFNE), University of Foggia, Italy

VALORIZATION OF VALUABLE PRODUCTS FROM RED SEAWEED.
Sruthi Kumar, Department of Food Science, Aarhus University, Denmark.

BIOCHEMICAL CHANGES IN *ULVA SP*. UPON PROTEIN EXTRACTION.
Signe Hjerrild Nissen, Department of Food Science, Aarhus University, Denmark.

TASTE-SEA – SEA-VEGETABLES WITH ENHANCED FLAVOR FOR FUTURE SUSTAINABLE FOODS.
Evangelia Zioga. DTU - The National Food Institute, Denmark.

USING QUANTITATIVE STORYTELLING TO IDENTIFY CONSTRAINTS IN RESOURCE SUPPLY: THE CASE OF BROWN SEAWEED FOR BIO-BASED PLASTICS.
Maddalen Ayala Cerezo. Aalborg University, Denmark.

ABSTRACT #19

KEYNOTE TALK: SEAWEED IN THE GLOBAL BLUE BIOECONOMY

SPEAKER

Steffen Cole Brandstrup,
Copenhagen University,
Former World Bank.

Steffen Hansen will give an overview of past and ongoing work specific to the World Bank Group, the Global Environment Facility, Lloyds Register Foundation and other stakeholders in advancing the seaweed in the global blue Economy. Amongst other elements, Steffen will highlight the World Banks Groups work via the Aqua business Investment Platform, but also ongoing work by the Lloyds Register Foundation in advancing global seaweed standards.

Steffen Hansen has spent most of his career working in multilateral organizations towards advancing the management of shared fresh and marine resources. His focus areas include institution building, optimized water and nutrient resource management and the further advancement of the catch fisheries and aquaculture sectors. Recently he joined the Department of Food Science, University of Copenhagen, as a Ph.D. student to advance science informed nature positive seaweed value chains, including by developing a Theory of Change for the sector.

ABSTRACT #20

MARIKAT – UNLOCKING THE POTENTIAL OF AQUATIC BIORESOURCES

SPEAKER

Maria Dalgaard Mikkelsen
PhD, DTU Bioengineering,
Denmark

Maria holds a PhD in plant molecular biology from Copenhagen university. Maria has for the last 6 years worked at DTU primarily working on brown seaweed polysaccharides with main focus on fucoidans. Maria has a long carrier in enzyme technology and are currently focusing on fucoidan acting enzymes.

The technological objective of the MARIKAT BlueBio project is to unlock the potential of polysaccharide active enzymes from microbiomes, to provide enzymatic tools for emerging biorefineries in Europe, using seaweed polysaccharides as a feedstock for bioconversions to value added derivatives.

The MARIKAT project includes biosourcing, characterization and industrial development of enzymes identified in extremophilic marine microbial genomes and metagenomes from Iceland and Greece. In addition, various auxiliary enzymes will be targeted e.g. enzymes for removing or changing substituent patterns of polysaccharides, and for tailoring seaweed polysaccharides for high value functionalities. MARIKAT will discover enzymes and expand the range of products that can be derived from seaweed, including products such as bioactive oligosaccharides and rare sugars. Structural determinants of bioactivity will be elucidated for various enzymatic products. The potential of using these enzymes for production of oligosaccharides in the pharmaceutical industry, will be evaluated. The targeted markets are food (specifically the food beverage and the health food markets); pharma and the skin-care industry.

The developed enzymes and enzymatic processes will be introduced to the market through commercial channels within the consortium, partners, networks as well as through outreach and dissemination to stakeholders and potential third-party collaborators and clients. The project also includes a Human Capacity Building (HCB) and mobility element and a broad public awareness and information program concerning seaweed biorefining. The knowledge obtained through the Marikat project, will be further developed for industrialization in the new Horizon Europe grant project SeaMark.

AUTHORS

Maria Dalgaard Mikkelsen[1], Eva N. Karlsson[2], Guðmundur Ó. Hreggviðsson[3,4], Ioannis V. Pavlidis[5], Lene Lange[6] and Anne S. Meyer[1]

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ABSTRACT #21

BLUE-BIOREFINERY OF SEAWEED *GRACILARIA GRACILIS*: FROM NUTRIENTS REUSE TO BIO-BASED PRODUCTS

SPEAKER

Matteo Francavilla
Associate Professor,
Dept.of Agriculture,
University of Foggia, Italy

Associate Professor in Organic Chemistry at UNIFG, Department of Agriculture Science, Foods, Natural Resources and Engineering (DAFNE); Responsible of STAR*-Facility Centre, a technological hub of University of Foggia for biomass valorization; Lecturer in "Organic Chemistry", "General Chemistry" and "Biomass and Biorefinery". Laurea cum laude in Organic Chemistry at University of Rome "La Sapienza", PhD in Sustainable Agro-Ecosystems at University of Foggia, Master in "Natural Organic Compounds" at University of Rome "La Sapienza". His research activity's main topics include the valorization of biomass (including algae) through extraction, purification and characterisation of fine chemicals, bioactive compounds and biomaterials; Biorefinery processes; Green Chemistry applied to biomass valorization. His research interests are currently addressed towards nanoplarticles production using biopolymers as template, platform compounds, and biofuels production from aquatic and terrestrial biomass.

In order to develop a bio-based economy, with all its related opportunities for growth and employment, holistic and sustainable approaches are needed including a greatly improved material and energetic utilization of biomass and wastes. In this contest, Biorefineries can take on an important task in this process.
Algae (micro and macro) are considered a future biorefinery feedstock and incorporate costly processes which can determine the sustainability of algae-based products. The algae biorefinery process chain consists essentially of system components for the pre-treatment and preparation of algae, as well as for the separation of algae components (primary refining) and the subsequent conversion/processing steps (secondary refining) as well as the valorization of by-products of the processes. The by-products that occur as a result of primary- and/or secondary refining can be used to supply process energy or, where applicable and in compliance with statutory requirements, they can be further processed into materials.The main objective of this study was to investigate the production of valuable industrial algae products (with high added value) for pharmaceuticals, nutraceuticals, cosmetics, agrochemicals, green chemicals and biomaterials, by investigating a cascade biorefinery which can valorise also the wastes and the residues for fuels and adsorptive materials via pyrolysis to achieve sustainability.
This study points out the possibility of using the red seaweed Gracilaria gracilis of Lesina Lagoon (Southern Adriatic Sea, Italy), where a stable coverage was found. as a multi products source for several intriguing applications in the concept of Biorefinery

AUTHORS

Deborah Raccaa, Mauro Maronea, Francesco Contilloa, Paolo Marascoa, Massimo Monteleonea, Giovanni Normannob, Matteo Francavilla*
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ABSTRACT #22

SEAWEED METABOLOMIC PROFILING DISCRIMINATES BETWEEN BROWN, RED, AND GREEN SPECIES BY NONTARGETED LIQUID CHROMATOGRAPHY-MASS SPECTROMETRY

Marine macroalgae or seaweeds can be divided based on their phylogenetic origins: brown (Phaeophyceae), red (Rhodophyta), and green algae (Chlorophyta). Their morphology and adaptation to the environment, among other things, contribute significantly to their metabolic diversity. We explored the metabolic profiles of brown, red, and g Mihai-Victor Curtasu reen seaweeds using non-targeted quadrupole-time-of-flight mass-spectrometry. Twenty-two species (11 brown, 7 red, and 2 green seaweeds) were sampled from wild harvest or cultivation from Nordic waters. Asparagopsis taxiformis was sampled in Australia from wild harvest. Data collected in negative electrospray ionization mode was analyzed by principal component analysis (PCA). The PCA revealed a distinct grouping of metabolic profiles based on the pigmentation and phylogenetic group. Two brown species, i.e. Sargassum muticum and Dictyota dichotoma, as well as the red species Asparagopsis taxiformis separated along the first two PC indicating a distinct profile. Compound annotation revealed several sulfonated compounds from S. muticum, particularly high intensities of undecylsulfate, decylsulfate, lysophosphatidylethanolamine (22:6/0:0), and lysophosphatidylethanolamine (20:5/0:0). Characteristic for D. dichotoma were putatively annotated compounds from the chemical category of glycosylglycerols or saccharolipids. A. taxiformis discriminated through the presence of haloforms, particularly dibromoacetate and 2-bromo-2-iodo-acetic acid. Further analysis showed a specific grouping of the seaweeds by similarities in phylogenetic origins. Four species of Fucus (F. serratus, F. evanescens, F. spiralis, and F. vesiculosus) clustered together indicating very similar metabolic profiles between members of the same genus. Description of the metabolome profiles and identification of specific metabolites can provide extensive information for selecting macroalgae species in different industries and production systems.

SPEAKER

Mihai Victor Curtasua Mihai
Postdoctoral researcher,
Aarhus University, Denmark

Mihai-Victor Curtasu is a postdoctoral researcher at Aarhus University Viborg-FOULUM (Denmark). He graduated from AU in 2019 with a Ph.D. degree in animal science where he has focused on molecular nutrition and nutritional metabolomics research. Using non-targeted metabolomics techniques, he has examined the effects of dietary interventions on the nutrition and health status of animals by studying small molecules and metabolic pathways in cells, biofluids, and tissues. Using the same techniques, he is currently examining seaweeds and their potential use in animal nutrition and feed additives for methane reduction in cattle.

ABSTRACT #23

KEYNOTE TALK: POTENTIAL OF BROWN SEAWEED CONTAINING THE LIVER X RECEPTOR AGONIST 24(S)-SARINGOSTEROL IN THE PREVENTION AND TREATMENT OF ALZHEIMER'S DISEASE

SPEAKER

Monique Mulder
Associate professor,
Erasmus MC, Internal Medicine,
Netherlands

My research focusses on lipid/lipoprotein metabolism in relation to cardiometabolic and Alzheimer's disease. My favorite topic is the potential of seaweed-derived sterols, that activate liver x receptors (LXR) in the battle against the development of AD, initiated together with Dr Vanmierlo in collaboration with Prof dr Lütjohann,. This directly links to my passion for research on the interaction between diet, metabolism and brain function. Because synthetic LXR-agonists have a broad application in chronical aging related diseases, I investigate the potential therapeutic role of seaweed-derived in the treatment of aging-related dementia, cardiovascular disease and diabetes mellitus.

Alzheimer's disease (AD) is a progressive neurodegenerative disorder for which no effective therapy is available yet. Liver X receptors (LXRα/α) are promising therapeutic targets in AD because of their key role in the regulation of lipid homeostasis and inflammatory processes. We reported that activation of LXR by synthetic agonists restores cognitive decline in AD mice. Because synthetic agonists mostly induce hepatosteatosis and hypertriglyceridemia, we explored the potential of brown seaweeds containing oxyphytosterols that can activate LXRs without inducing adverse effects. We found administration of the seaweed Sargassum fusiforme or its lipophilic extract containing the LXR agonist 24(S)-saringosterol to improve memory and reduce amyloid-α (Aα) deposition in mice with Alzheimer's disease (AD), without inducing hepatic steatosis and hypertriglyceridemia as induced by synthetic LXRα/α agonists. Administration of pure 24(S)-Saringosterol also prevented cognitive decline in AD mice independent of effects on Aα load. The 24(S)-saringosterol-induced prevention in the increase in Iba1 in AD brains, suggested involvement of anti-inflammatory effects in the prevention of cognitive decline.

Next we screened European and Dutch saringosterol-containing brown seaweeds for their LXR-activating capacity. We observed positive effects for LXRα/α-activation for Himanthalia elongata, Saccharina latissima, Alaria esculenta, Fucus vesiculosus and Sargassum muticum. In line with the LXR activating capacity these extracts upregulated the expression of the LXR-targets ABCA1, ABCG1 and APOE.
In conclusion European brown seaweeds containing 24(S)-saringosterol similar to Sargassum fusiforme can activate LXRs. Brown seaweed may provide sustainable and affordable compounds for the prevention of AD afflicting thousands of global citizens and potentially for other neurodegenerative diseases.

ABSTRACT #24

DEVELOPING NOVEL PREVENTIVE HEALTHCARE PRODUCTS: CHALLENGES AND OPPORTUNITIES

SPEAKER

Ghislaine Robert-Nicoud
IP manager & Material Scientist,
Sigrid Therapeutics AB, Sweden.

Lifestyle diseases, caused by poor diet and physical inactivity among others, are rising worldwide. Each year 70% of all deaths globally – 40 million – are attributed to lifestyle diseases such as obesity, type 2 diabetes and heart disease. Lifestyle changes, such as exercise and healthy diet, are the first in line intervention for lifestyle diseases but adherence is low. New innovative therapies are needed to complement lifestyle changes in the prevention and treatment of diseases such as diabetes and obesity.

In the search of natural ingredients that could be used to answer this highly unmet clinical need, seaweed stands out due to its many health benefits and positive environmental impact. The potential of using seaweed to develop new consumer focused products for the prevention and treatment of lifestyle diseases is promising.

IP manager & Material Scientist at c. Sigrid Therapeutics is a clinical stage healthtech company with expertise in development, pre-clinical and clinical testing of novel biomaterials. Ghislaine Robert-Nicoud is a chemist proficient in the application of chemistry to biotechnology and medical sciences. After a Ph.D. in Biomaterials at the University of Manchester (UK), Ghislaine gained expertise in product development and formulation, including the production of prototypes for consumer user trials while working at Walgreens Boots Alliance (UK) and Sigrid Therapeutics (Sweden). She also has extensive experience in preparing patents applications focusing on novel material compounds and their uses.

ABSTRACT #25

FUTURE DANISH AGAR/ FURCELLARAN VERS 2.0 BUSINESS IN DENMARK

SPEAKER

Susan Løvstad Holdt
Associate Professor, DTU Food, Denmark

Susan Løvstad Holdt, Industrial-PhD, is a biologist and associate professor at DTU Food. Her field of research is within seaweed composition, bioactives and technologies for extraction. Furthermore, she is involved in research on seaweed as a food, legislation, standardization, retaining the qualities of seaweed, but also having focus on reducing the contaminant found in seaweed.

Furcellaria lumbricalis harvest and extraction for Danish agar was a large business after the second world, but over-harvesting stopped the success. New floating population have been "refound" and the potential of starting a semi-refined business opportunity was investigates in the Future Furcellaria Trust project supported by Fiskeristyrelsen.

According to the tests performed in this study, it is possible to conclude that a simple refining process, represented by KOH semi-refined extraction, is not enough to produce gel out of the dried Furcellaria powder. However, having fermentation as a pre-treatment guarantee the breakage of the cells, making the polysaccharides available to enable gel production. The fermentation with lye gave a slightly better result of the gel consistency. On the other hand, it also revealed a greater protein loss.

Thus, considering the conditions applied in this study the differences in quality might not be enough to recommend one pre-treatment over the other. Additionally, the loss of protein during the process was considerably high, thus there is a potential opportunity in recovering it from the supernatant. It was not possible to understand if the KOH treatment enhanced the best yield. In conclusion, despite the need for more detailed research, the current investigation sees semi-refined furcellaran extraction as a potential way to start a new industry around *F. lumbricalis*.

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