

# A Taste of Things to Come with Sea Kelp

- ★ The Norwegian Research Council project SusKelpFood addresses the challenges of producing kelp for Nordic and European food industries. Project Leader, **Dr Pierrick Stévant, Ph.D** and **Dr Arne Duinker, Ph.D** explain their research, undertaken to bolster the efficient production of safe, nutritious and tasty seaweed food products.

**Farming kelps** (i.e. brown seaweeds) has many advantages to growing land-based crops and has been identified as a food source that can match the requirements of at least four EU sustainability goals, including responsible consumption and production, life below the water, industry innovation & infrastructure, and climate action.

"It can be cultivated with virtually none of the inputs used for agriculture like fertiliser, chemicals, soil and fresh water, relying on sunlight for growth," explained Stévant.

Seaweed has the potential to be a cost-effective, nutritious and abundant food source and as a benefit, it absorbs carbon dioxide and can boost marine biodiversity.

"There are more than enough good arguments for

farming kelp," adds Duinker. "It is an amazing food choice in terms of the flavours and the functionality and the kinds of nutrients you get from these plants."

## From the Ocean to the Plate

The growing processes are relatively straightforward. Young kelp plantlets are first grown in indoor facilities under controlled conditions before being seeded on strings. They are then deployed at sea in autumn to be harvested in late spring.

"The growth starts to increase around late March when the light comes, and from there until the end of April there is about two meters of growth. It grows very quickly. The focus of our project starts when the kelp biomass is harvested," described Stévant.

The harvesting occurs in a relatively short, and intensively busy period, as the production of several hundred tonnes of seaweed can be completed in just a few days. However, kelp production needs to explore new and more efficient conservation and processing methods to ensure commercial success as a mainstream food source for Europe.

Seaweed, especially kelps, has long been known as a widespread food source in Asian countries like China and Japan, as a staple ingredient in diets. Although

experience and know-how from Asian kelp production should be drawn, this model may not be replicable in Europe. In Asia the kelp species produced are different, the labour costs can be far cheaper, and sun exposure is often more predictable and reliable for drying out the seaweed naturally to preserve it, post-harvest.

It is necessary to analyse how much energy is used to process and preserve the seaweed as it impacts overall sustainability.

"As drying large quantities of seaweed may be energy-intensive, the end-product is not so sustainable anymore. Our job is to look at different processes for the stabilisation of kelps that use less energy and yield high-quality products, in terms of nutrients, food safety and flavour.

"Unlike Asian countries, sun-drying is not a viable option in Northern Europe. Fermentation is an interesting alternative to drying for the preservation of large quantities of kelp with virtually no or minimal energy input to the process. But optimised and reliable methods are not established yet," said Stévant.

"We investigate different technologies and test them. We look at the product from the perspective of sustainability, so when using a method, we estimate how much energy is being used in the process, what materials are employed during the process, and how long these materials last."





Kelp crisp on fish. Credit: Arne Duinker.

### A Practical Project

The researchers are working hand-in-glove with the major Scandinavian food company, Orkla Foods together with the leading kelp producers in Norway to turn kelp from a relatively niche product into a widespread, pervasive food source. "We've established a good synergy between researchers with expertise in kelp processing, food science and engineering, food safety, sensory science and sustainability evaluation, and industrial partners with practical knowledge of commercial food and kelp production and processing systems," said Stévant. The research focuses on improving and innovating post-harvest processes like fermentation and pre-treatments, to keep the kelp products safe, nutritious and tasty.

We are studying the two main kelp species cultivated in Norway i.e. sugar kelp and winged kelp. Processing techniques are tested and refined at the laboratory and our industrial partners' facilities to reduce the levels of potentially toxic elements, such as iodine which is high in kelps. We also investigate potential risks linked to seafood allergens. There is a need to understand how much of a problem these potentially harmful substances are, in the context of including kelps in food products with a broad distribution, and if these concerns are overstated.

"The levels as an ingredient are not a problem," states Duinker. "The species that we are working with are not particularly high in heavy metals compared to other seaweeds. I've been writing a few reports on the content of the contaminants in seaweed. If you compare high-mineral seaweeds to other high-mineral foods like blue mussels, for example, the levels of heavy metals are the same and we never worry about using blue mussels. This is

one of the challenges we are facing with such a new type of food, people are sceptical and it's easy to misunderstand things."

Excessive iodine intake may have adverse effects on thyroid gland function. Reducing the iodine level of kelps during processing has been a priority for the past years. This is easily done during production but kelp can lose a lot of its nutritional benefits during the process.

"We know that the iodine content can be quite high, so we have been researching methods to reduce it. At the same time, we want to keep the good stuff in the seaweeds and retain the best of the nutritional compounds," confirmed Duinker.

In this regard, the project found early successes by investigating new methods. Scientists from the team found a new technique that not only worked but was swiftly adopted by some commercial partners, to become an integral process for kelp food production.

Researcher Dr. Susan Løvstad Holdt (Technical University of Denmark) and industrial partner Dr. Linn Anne Bjelland Brunborg (Orkla Foods) with sugar kelp. Credit: Pierrick Stévant.



"This is the starting point of the project where we discussed how can we reduce iodine without losing all the nutrients," continued Duinker. "Normally, you would boil the kelp in fresh water so there is no iodine left but there are no nutrients either. We had a student that used warm seawater and it looked promising. In the first season of the project, this method was implemented in the whole production chain. Put the kelp in moderately warm seawater and the iodine goes out quickly and you retain most of the other nutrients much better than with previous methods."

### Planning for Change

Another challenge is the market for kelp food products has to be developed at the same time as developing the production. Essentially, the industry should only scale up in line with market growth.

It's clear that in Nordic and European countries kelp food products are a promising segment with great potential but if and when these products become a household ingredient, innovative solutions will be needed to secure commercial success. Market conditions can change quickly, so research and commercial interests will need to bend and adapt to the directions and speeds of change.

For kelp to be used as an ingredient it will need to be effectively marketed and attractive for Europeans to buy it. One key to such success is to get large and trusted food industry companies to implement kelp as an ingredient in their products.

Part of the project deals with analysing sensory properties and categorising flavour-active substances as well as to gain insight into the consumer perception of kelp-containing food products.

Throughout sensory evaluation sessions researchers have systematically described kelp ingredients from sugar kelp and winged kelp in terms of flavour, odour and texture and how these attributes are affected by post-harvest processing methods.

"We also evaluate shelf-life and identify key flavour compounds which are important steps in optimising the processing conditions to yield products with attractive flavours."

Seaweed can be a versatile food; noodles can be made from it, it can be served with crackers or fish soup and there's potentially a wide range of food products and recipes that can make sea kelp attractive for consumers as an ingredient. The umami or taste enhancing effects of adding seaweed is very interesting both for the food industry and for cooking at home. "It's salty, you can get this crunchiness – you can fry it, boil it!" enthused Duinker.



Researcher team from NOFIMA during harvest of sugar kelp cultivated on ropes. Credit: NOFIMA.

Regardless, the trajectory of Europe's food security means that aquaculture offers an attractive solution for feeding a population in a rapidly changing climate, that will further impact agriculture and land resources over time.

Duinker concludes: "We need more food

culinary applications. The first results from our consumer study show that there is a positive attitude and that respondents are willing to pay a little extra for kelp food provided that the kelp ingredient adds value to the product in terms of health benefits, flavour or sustainability.

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from the oceans, and to get enough food it needs to be in the bottom of the food chain, so the algae or the bivalves. In the long term, this is something we should do more of in Europe, as a way of getting more food out of the ocean to sustain a growing population. On the other hand, western consumers are relatively unfamiliar with kelp and need to be educated in using this type of ingredient in everyday

However, there is a strong need for more information about these new foods.

"There is a hunger problem in the world but there is also this hidden hunger which is a lack of nutrients in food. Seaweeds can provide a lot of minerals for long-term health in large parts of the world where there are problems with malnutrition. There is a long way to go but it's important to start."

Cod fillet served with leeks and sugar kelp. Credit: Pierrick Stévant.



## SUSKELPFOOD

### SUSTAINABLE INGREDIENTS FROM CULTIVATED KELP TO THE FOOD INDUSTRY

#### Project Objectives

Kelp aquaculture is a sustainable way of producing biomass for food. SusKelpFood is testing and developing energy-efficient processes to conserve and prepare kelps, reducing the iodine and heavy metal content and at the same time preserving nutrients, other bioactive substances and flavour. Enabling the use in large-scale food applications.

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#### Project Partners

<https://www.suskelpfood.com/consortium/>

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Dr. Pierrick Stévant holds a PhD in marine biotechnology and food science specialized in seaweed processing and its effect on quality to food applications. He has worked with seaweed-related topics since 2012 and has experience with seaweed cultivation.

Dr. Arne Duinker holds a PhD in bivalve physiology and has been working with seafood since the late 90's, with a wide variety of species including bivalves, crustaceans and fish. This work has included seaweed since 2014 with several projects with the seaweed industry focusing on seaweed as food.

