

Development of seaweed cultivation for food

The green seaweed *Ulva* spp., locally known as Havsalat has been successfully cultivated year-round in northern Norway under controlled laboratory condition in the state-of-the-art facility of NIBIO-Bodø. The techniques learned by Daniel Fonn Aluwini of Arctic Seaweed AS will be applied to develop an on-site cultivation facility in Andøy. The purpose is to produce seaweed for food and he has already contact with interested restaurants. Within the project TransAlgae, Daniel has co-operated with NIBIO and Michael Y. Roleda for developing cultivation techniques of seaweed.

ABOUT SEAWEED

Different blade-forming *Ulva* species commonly known as sea lettuce or Havsalat in Norwegian is an edible green seaweed. *Ulva* blade is thin and flat and can be olive green to dark green in color. They grow on rocks and can be found in the intertidal and subtidal areas of the shore. *Ulva* have a worldwide distribution and large quantities grow in areas where nutrients are abundant.

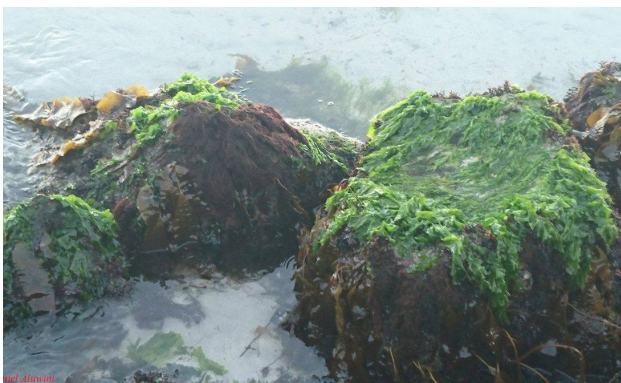


Fig. 1. Seaweed from Andøya. Photo: Daniel Fonn Aluwini

Fresh *Ulva* can be eaten raw in salads while dried *Ulva* can be used as garnishing or cooked in soups. It is high in protein, soluble dietary fiber, and a variety of vitamins (B12, B3, and C) and minerals, especially iron, calcium, manganese and magnesium.

Furthermore, it contains Ulvan, a complex sulfated polysaccharide that exhibits antiviral, antihyperlipidemic, and antidiabetic effect in animal experiments. Moreover, their antioxidant and phytochemical profiles give *Ulva* several possible applications for food, pharmaceuticals or animal feed.

In northern Norway, the occurrence of *Ulva* in nature is very seasonal. They require optimum temperature and light to start growing in spring.

With increased availability of nutrients (nitrogen and phosphorus) and increasing daylength, light and temperature, *Ulva* biomass also becomes abundant towards summer. *Ulva* blades cannot survive the cold temperature and low light during late autumn and winter in northern Norway.



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Fig. 2. Different *Ulva* species and morphology.

CULTIVATION OF SEAWEED

Ulva is mainly cultivated in the Asia-Pacific regions, using tropical species of the filamentous *Ulva*. In Europe, *Ulva* is cultivated in Portugal, France and Ireland. Arctic Seaweed AS and Daniel Aluwini is now establishing a cultivation facility in Norway, in the municipality of Andøy in Vesterålen. This will be the northernmost cultivation facility in the world of its kind. Andøya have good cultivation conditions because of the Gulf stream which is upwelling warmer and nutrient-rich water from the depth to the subsurface and accessible for seaweed growth.



Fig. 3. Daniel Fonn Aluwini with seaweed on Mørkvedbukta NIBIO. Foto: Per Magnus Hansen

TANK CULTIVATION AT NIBIO

Different *Ulva* strains were cultivated in 100L and 1000L tanks. Seawater supply sourced from the depth of the fjord is continuously free flowing. Water temperature, light intensity and daylength were adjusted to optimum condition to support high growth rates. Biomass is harvested and freeze-dried for further analyses of protein and lipid profiles. Figure 4 shows that *Ulva* cultivated under optimum temperature, light intensity and daylength showed high growth rate.

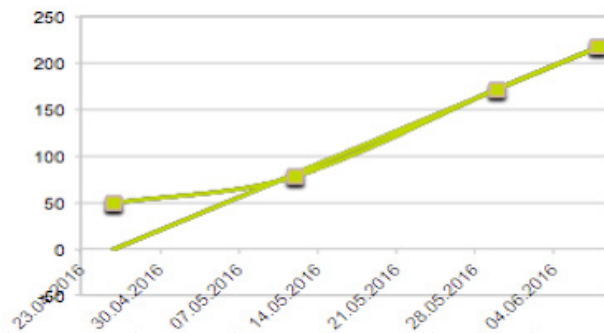


Fig. 4. Growth rate of *Ulva* during tank cultivation. X-axis is time and y-axis is biomass (grams).

SEAWEED ON THE MENU

Ulva can be served fresh as salad or as topping. It is also possible to dry or fry *Ulva*. If dried, it is usually grounded and used as spice. It is a delicacy in Michelin-restaurants.

In Europe, the use of different seaweed species (*Ulva* included) is mainly used and served in French restaurants, but it has started to gain more interest in other western countries, e.g. Norway and Sweden, among others.



Fig. 5. *Ulva* served as fresh topping on a meal. Photo: Peter Neumann

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