Deliverable D2.2 Report on drying and semi drying algae biomass for storage of algae biomass for valorisation high-value added products

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Work package 2

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Summary

General summary

The overall objective of WP2 is the preparation for microbial refining and extraction of value-added compounds. This is achieved by the conditioning, storage and mineral removal of freshly harvested seaweeds to be converted to high-value compounds in subsequent work-packages, i.e. develop methods for conditioning, pre-treatment and storage of harvested seaweed for microbial and chemical refining. The work will focus on the following areas:

- Conditioning of seaweed, i.e. dewatering, drying and ensiling to facilitate storage, and further recovery of all identified algae compounds
- Combined storage and in-situ (biological and chemical) pre-treatment
- Optimal recovery of residuals (including mineral and salt) from the conditioning processes

This Deliverable 2.2 describes the drying process in both laboratory, pilot and industrial scale.

Summary for laboratory scale:

Drying kinetics seaweed for industrial processes is a balance between energy consumption, time, and preservation of carbon. In laboratory scale, drying temperature can be an important factor when quantifying seaweed compounds. *Saccharina latissima* harvested from the Faroe Islands by Ocean Rainforest was used to test the effect of oven drying at different temperatures on the drying time and identify thermosensitive compounds. Furthermore, an option of dewatering by pressing was explored for future study. Carbohydrates and proteins both seemed to be affected by increasing drying temperature, however lower temperature drying still retained some moisture in the sample. Screw pressing seaweed is an option that can aid in moisture reduction alongside drying. Screw pressing has previously explored for *Saccharina latissima*, which is notoriously difficult in laboratory scale due to the viscous press juice. An option of dewatering by pressing was explored for future study.

Summary for pilot scale:

It is important for the quality of the algae to store the seaweed in the after-drying chamber until it is packed in air-tight food-grade plastic bags. Even dry seaweed will increase moisture content if it is stored in an open container in a raw and humid environment.

Summary for industrial use.

In this Deliverable, focus is on the upstream processes of kelps and drying technologies based on industrial trials in Europe, some of which were carried out by ALGAIA with dryer manufacturers. The trials mainly refer to kelps harvested from wild stocks for alginate extraction and will provide guidance for cultivated kelps such as *Saccharina latissima* or *Alaria esculenta.*

Preliminary steps to drying are necessary to insure a stable, safe and homogenous biomass. Based on literature and our trials at ALGAIA, we describe various technologies and processes such as the ancient sun drying vs technologies (rotary dryers, conveyor dryers, flash dryers and fluid bed dryers). We later describe the impacts of drying, both for the preservation of compounds of interest and for the costs it incurs. Indeed, it is crucial to select a technology that does not affect the content and bioactivity of the numerous compounds in kelps. A group of molecules “highly thermosensitive“ where temperatures above 40°C in an oxidative environment affect the likes of pigments, fucoxanthin and other carotenoids; vitamins; proteins and peptides; phlorotannins and mannitol. Another group, that gather structural and reserve polysaccharides can be described as “thermosensitive” as they are slightly more tolerant to higher drying temperature (between 40 and 70°C) prior to extraction. This encompasses the alginates, the fucoidans, the laminarins (with the exception of mannitol ending) and the cellulose.

We conclude by the fact that drying kelps is a challenge that involves numerous parameters and is one of the current limiting factors to the emerging seaweed farming industry in Europe. Various technologies have been proven sound to dry kelps, and we recommend the use of flash dryers or multipass conveyor dryers for a more cost-efficient technology, while other technologies appear to be inefficient in removing moisture from this challenging biomass.

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