The Effects of Freezing and Thawing of *Saccharina latissima* and *Alaria esculenta*

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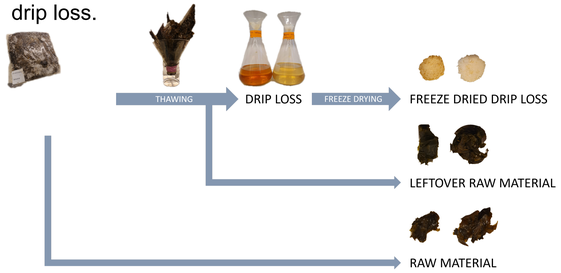
Introduction

Freezing is a popular preservation method for fresh seaweed, as it is a relatively easy and often accessible way to prevent deterioration after harvest. However, freezing and thawing results in a substantial loss of liquid.

In this study, the biochemical composition of drip loss from thawing of frozen samples of the species *Saccharina latissima* and *Alaria esculenta* was studied to assess the effect of freezing and thawing on the seaweed raw material and potential applications for the drip loss.



Materials and Methods

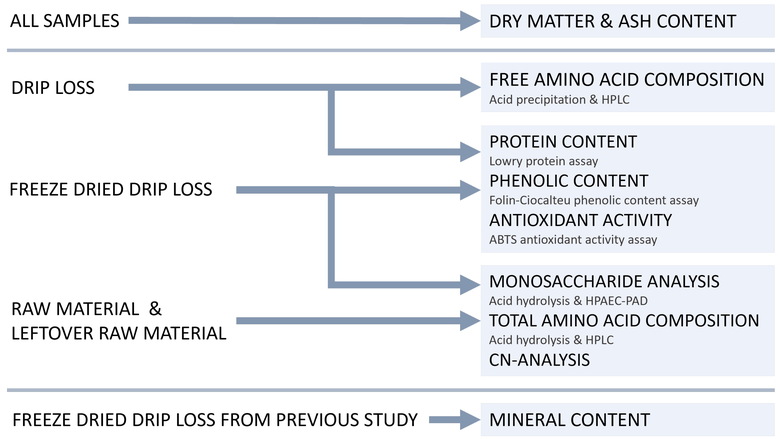


Figure 1: Flow chart of analyses conducted on drip loss samples from thawing, freeze dried drip loss samples, leftover raw material after thawing and raw material from samples of the macroalgae species *Saccharina latissima* and *Alaria esculenta*.

Results and Discussion

Thawing of *Saccharina latissima* and *Alaria esculenta* resulted in drip loss of 49% and 55% of wet weight, respectively. The dry matter content of the drip loss samples was on average 6.6%, of which an average of 71% was minerals. These minerals were mainly sodium, potassium, and iodine, as well as some arsenic, mercury and cadmium.

The carbohydrate and amino acid analyses showed a substantial loss of mannitol and free alanine, as well as the loss of some free glutamic and aspartic acid.

The concentrations of phenolic compounds and proteins were low, and these, as well as the antioxidant activity, were determined to be higher in the *Saccharina latissima* drip loss than in the *Alaria esculenta* drip loss. The protein content seemed to be mostly small peptides or free amino acids.

Conclusion

Altogether, the nutritional value of the seaweed was not substantially affected by freezing and thawing. Additionally, the mineral content of the drip loss samples indicated a favourable reduction of iodine and heavy metal content. The loss of liquid during thawing might even make subsequent drying processes easier due to the reduced water content. However, loss of mannitol, alanine, glutamic acid and aspartic acid could cause an altered flavour profile of the leftover raw material.

The drip loss in itself did not seem to have any apparent direct uses. The most likely use of the drip loss samples seemed to be for the extraction of functional compounds, especially iodine or mannitol, for further industrial uses.

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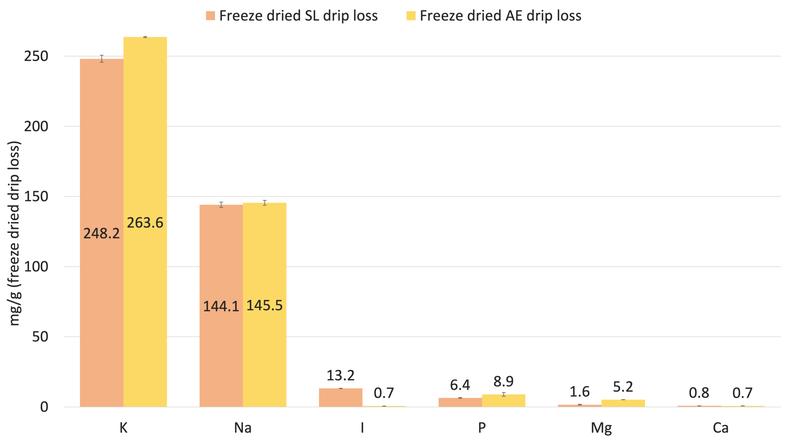

Figure 2: Amount of the minerals potassium (K), sodium (Na), iodine (I), phosphorus (P), magnesium (Mg) and calcium (Ca) present in the freeze dried drip loss samples from *Saccharina latissima* (SL) and *Alaria esculenta* (AE) given in milligrams per gram freeze dried drip loss sample.

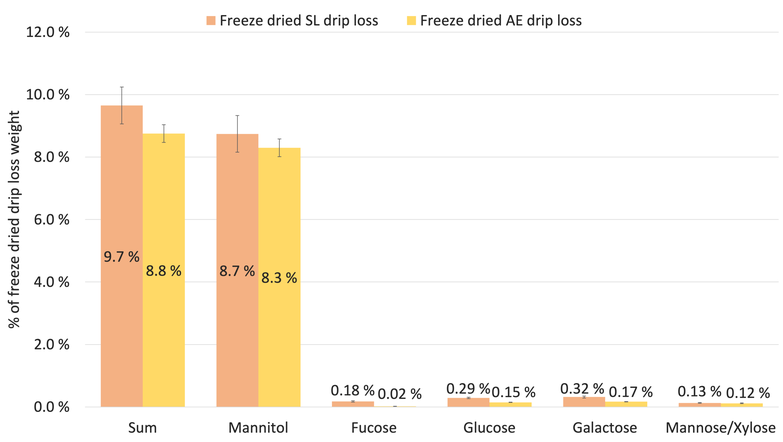

Figure 3: The carbohydrate composition of the freeze dried drip loss samples from *Saccharina latissima* (SL) and *Alaria esculenta* (AE). The sum represents the sum of all the shown carbohydrates. The concentrations are given in percent of freeze dried drip loss dry weight.

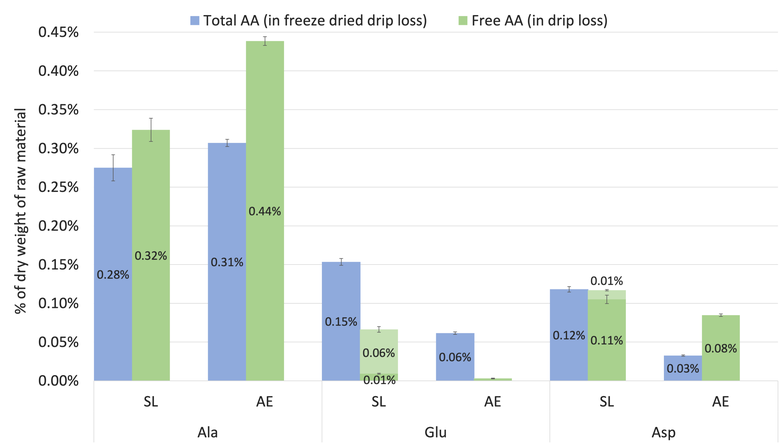

Figure 4: Comparison of total amino acids and free amino acids for alanine, glutamic acid and aspartic acid in *Saccharina latissima* (SL) and *Alaria esculenta* (AE) drip loss from thawing. The values are given in percent of dry weight of the macroalgae raw material. The slightly lighter green sections in the columns for glutamic acid and aspartic acid as free amino acids represent the free glutamine and asparagine, respectively.

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