EXTRACTION OPTIMIZATION FOR HIGH VALUE PRODUCTS FROM *LAMINARIA HYPERBOREA*

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1. Introduction

Laminaria hyperborea (stortare, *nor.*) is a brown macroalgae found in large quantum along the entire Norwegian coastline (60 million tons) [1]. The algae contains a variety of high value products that are relevant for use in food-, feed-, and pharmaceutical industries [2].

Historically, *Laminaria hyperborea* has been exploited predominately for only a single chemical; alginate. In this process the ocean is polluted due to use of formaldehyde, a toxic chemical, and considerable algae biomass is discarded as waste. A total utilization approach will aim for a more sustainable bioprocessing of the algae and prevent aquatic pollution by toxic chemicals. This contributes immensely to **SDG 14** – *Life below water*. Particularly targets **14.1**; reduce marine pollution, **14.7**; increase the economic benefits from sustainable use of marine resources, and **14.A**; increase scientific knowledge, research, and technology for ocean health.

To extract new high value products from *Laminaria hyperborea*, new research must be performed. This includes extraction optimization, purification processes, and characterization and quantification of polyphenols. Polyphenols are specialized molecules with several health promoting activities that is associated with reduced risk of chronic diseases as cancer and cardiovascular diseases, as well as having protective effects on diabetes, Alzheimer's, and obesity [3, 4].

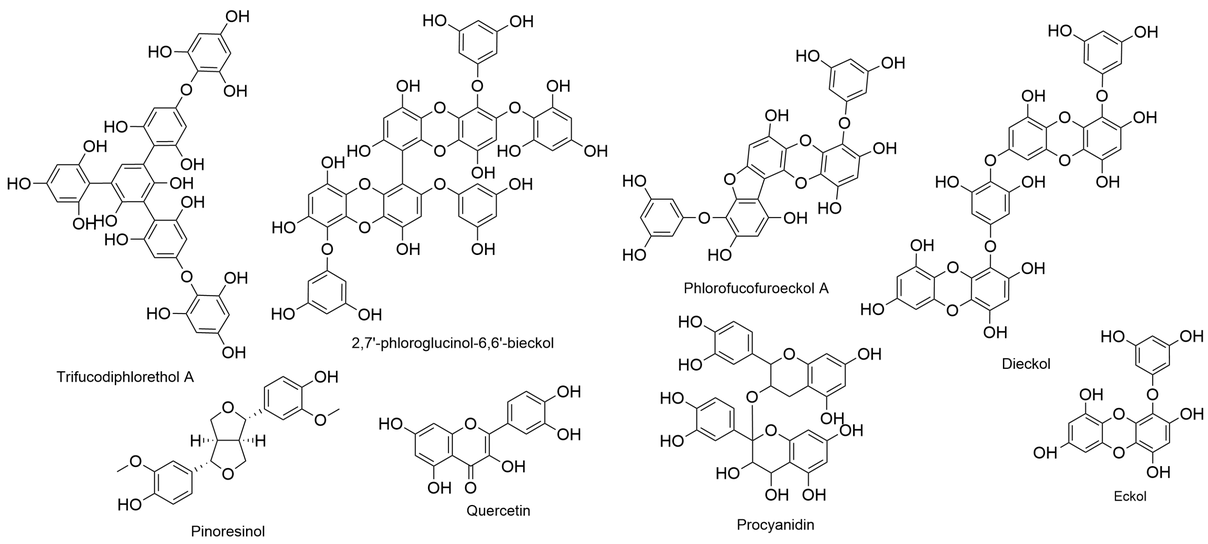

Figure 1: Chemical structure of different polyphenols, illustrating the difference and complexity of the compound group.

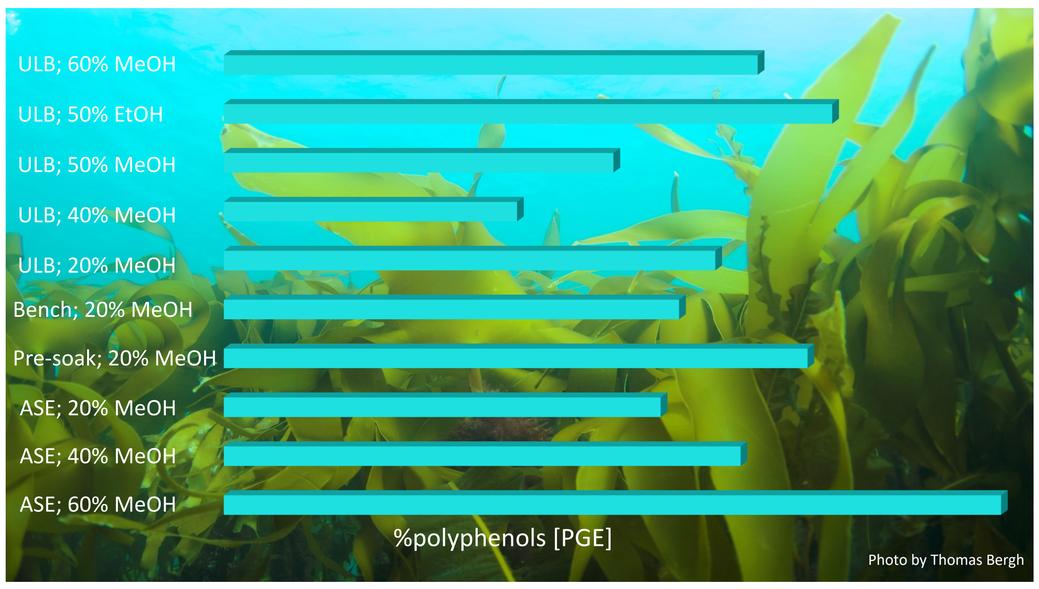

Figure 2: Polyphenolic yield in *Laminaria hyperborea* using different extraction methods. Showing that using ASE with 60% methanol yields the highest polyphenolic percentage.

2. Extraction optimization

Polyphenol extraction is difficult due to the complex nature of chemical compounds present and separation of these (**figure 1**). As part of the total utilization of *Laminaria hyperborea*, different extraction methods were tested for polyphenol extraction. This included traditional benchtop extraction, and two modernized methods; ultrasound bath extraction (ULB), and accelerated solvent extraction (ASE), with different ratios of methanol (MeOH) and ethanol (EtOH) (**figure 2**).

Following extraction, fractionation and purifications were performed, and **figure 3** and **4** shows the great diversity of chemicals in the fractions. These ongoing studies are showing promising potential of polyphenol isolation.

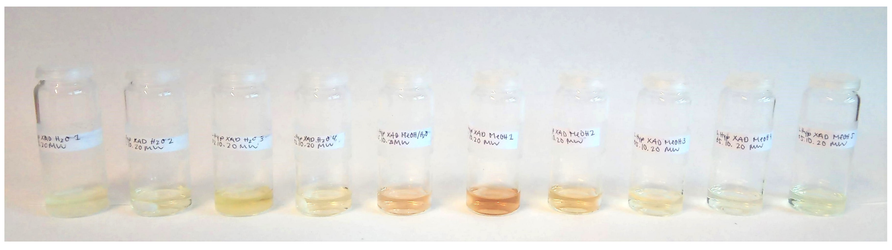

Figure 3: Polyphenolic extracts from *Laminaria hyperborea*. Fractions separated from laminaria hyperborea containing different chemical compositions and different colors.

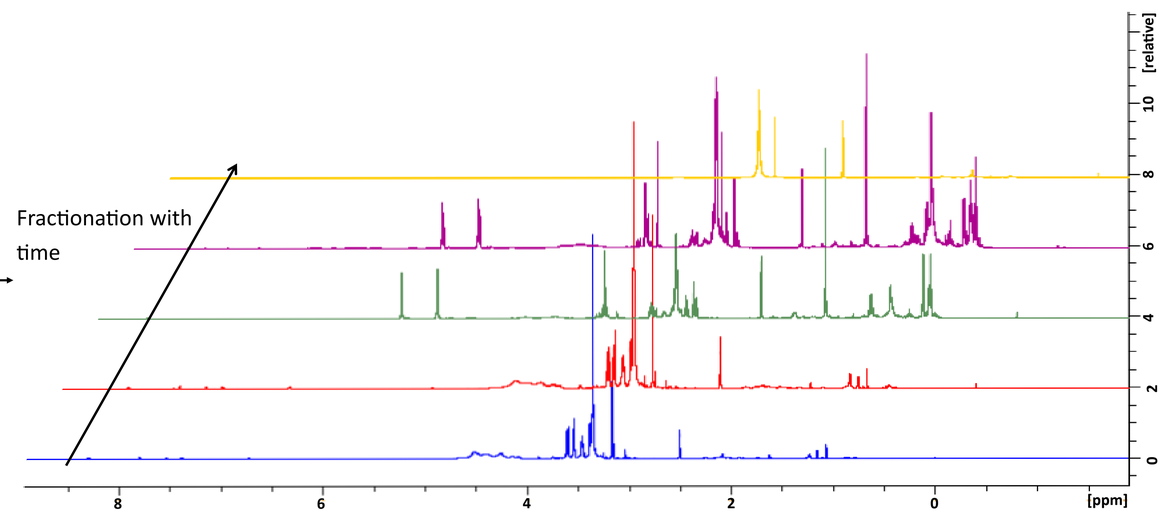

Figure 4: ^{1}H NMR spectra of selected fractions (fig 3) from *Laminaria hyperborea*. These overlaid spectra portray the complexity of polyphenol extraction where several samples show varying chemical characteristics.

3. Further work

This project will include and work towards:

- → Isolation and characterization of different high value products from *Laminaria hyperborea* using advanced analytical methods.
- → Furthering research on marine phenolics and their bioactivities.
- → Total utilization of a under-exploited marine resource for use in food-, feed-, and pharmaceutical industries.

4. References

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