Microwave-assisted solubilization of the brown seaweed *Ascophyllum nodosum* and screening of antioxidant characteristics

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In light of the current transition to more sustainable chemical feedstocks, seaweeds are increasingly investigated, in particular the class of brown seaweeds (Phaeophyceae) as they are shown to be rich in antioxidant compounds such as alginate, fucoidan, fucoxanthin, laminarin, etc. [1]. In the literature, component separation from seaweeds is often approached as a single compound extraction as opposed to overall solubilization and subsequent selective extraction of multiple components. The latter encompasses the potential to attain fractionation of the seaweed compounds, therefore overall solubilization is the focus of this work. In this study, solubilization is realized by means of microwave radiation with heating sustained by two simultaneous electromagnetic induced phenomena: dipolar rotations and ionic conduction [2]. In the context of biomass extraction, microwave-assisted solubilization is particularly interesting when performed above the solvent's boiling point, as internal pressure surges attribute to the subsequent release of the compounds of interest [3], [4]. The optimization experiments were conducted on the brown seaweed and abundant North Sea native *Ascophyllum nodosum*. Preliminary tests conducted on this seaweed showed a relatively high sulfur content (0.65%; i.e. fucoidan) and a relatively low total nitrogen (1.08%; i.e. protein) content. Since bacteria thrive at protein rich media, high contents of the latter are to be avoided. The first series of experiments were conducted to assess the influence of temperature (i), time (ii) and solid to liquid ratio (iii) on the solubilization efficiency of the seaweed. Another implemented criterion involved was minimal energy input per solubilized seaweed biomass (E/SSW) to avoid selection of the most energy-intensive conditions. The optimal solubilization conditions were determined using Response Surface Methodology (RSM) and the desirability method by Derringer & Suich (1980). Subsequently, various runs were performed at the determined optimal conditions and the zeta potential was evaluated as a means of predicting the antioxidant activity of the extract. In literature, extracts with positive values for the zeta potential have been demonstrated to display antioxidant characteristics [5]. Multiple seaweed species such as *Sargassum muticum*, *Fucus spiralis*, etc. were evaluated at various pH-levels to assess the dependency of the extract's acidity [6]. The results of this study attain high solubilization efficiencies, low energy dissipation and a deeper insight into mass transport of carbon, nitrogen and sulfur containing compounds, as well as predetermination of the presence of antioxidant compounds using simple zeta potential measurements.

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