Protein solubilization and rheological behavior in macro- and microalgae

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With protein contents higher than 30% for microalgae and between 10 – 30 % for some red seaweeds, algae are a commercially interesting source of protein for food and feed applications. However, the poor protein digestibility and solubilization yield of algae protein remains a challenge in the food industry. The low degree of solubilization associated with the processing needed to increase this yield often impairs their use and soy proteins are still the preferred option when considering alternative proteins. Also, its solubility influences other functional properties (e.g., emulsifying/foaming capacity and aggregation state), being determined by the amino acids' composition, native/denatured state, molecular weight, and environmental factors (e.g., temperature and pH).
This work aimed at improving the solubility of different macro (Porphyra dioica, Palmaria palmata, and Gracilaria verrucosa) and microalgae (Chlorella vulgaris, Nannochloropsis oceanica, and Tetraselmis chuii) protein fractions using different approaches.
Preliminary tests using Osborne fractionation indicated that algae proteins may be solubilized in water and alkaline solutions and not in salt or ethanol. Therefore, the pre-treatments were applied to maximize protein extraction with minimal impact on the technological functional properties using water or alkali. Tested pre-treatments included grinding, freezing/thawing, ultrasounds, enzymes, homogenization centrifugation, and pH shift alone or in different combinations.
The solubilized extracts were characterized in terms of solubilization yield, protein recovery, protein content and molecular weight. Gelling and emulsifying potential were also assessed for the extracts with higher protein content.
For macroalgae. protein solubilization was higher when considering water as solvent combined with other pre-treatments, with protein recoveries up to 40 %. For the considered microalgae, better results were obtained with 4 freezing/thawing cycles with extraction yields up to 20%.
The final protein extracts presented interesting emulsifying and gelling ability with possible applications as food or ingredients.
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