Project: AlgaePARC Biorefinery

Soft separation of microalgae

Aqueous two phase system for microalgae components extraction

Summary

Besides the potential in biodiesel production, microalgae biomass has other valuable components including; carbohydrates, long chain fatty acids, pigments and proteins. For biorefinery applications of microalgae biomass, components have to be released from the cells and separated from each other. For this purpose mild separation processes have to be developed to obtain more valuable biomolecules. This research focusses on the innovative extraction technology, Aqueous two phase system (ATPS) exploring new solvents as ionic liquids (ILs)

Aqueous two-phase extraction is a special case of liquid-liquid extraction, which involves a transfer of certain components from one aqueous phase to another. The difference between extraction in water-organic solvent system and aqueous two-phase systems is that in the last one the extractants have to be water-soluble. Since they are cleaner alternatives for traditional organic solvent systems, they are more suitable for protein extraction knowing that most proteins are either insoluble on organic solvents or are irreversibly denatured. In the ATPS phase formation occurs above certain concentration of the components each phase contains water and is enriched with one of the phase-forming components. The basis of separation in ATPS is the selective distribution of the compounds to be separated between the two phases. ATPS is going to be studied taking into account the benefits and side effects of using novel ionic liquids, to take the valuable biomolecules out of algae extracts. The main challenge is to maintain the functionality of the separated compounds.

Goal

To develop mild separation processes to obtain more valuable biomolecules. Furthermore, these processes should be applicable to a variety of feedstock, easily scalable, inexpensive and consume low energy. This research focusses on cell disruption and extraction technologies.

Experimental approach

First a screening of different aqueous two-phase systems for the separation of hydrophobic from hydrophilic components will be completed. These ATPS will be separately evaluated for the separation of model compounds. The second step is to apply the best ATPS to disrupted and non-disrupted cells. For example, Ribulose-1,5-bisphosphate carboxylase/oxygenase (RUBISCO) was selected as the model protein molecule as this is a plant protein and found in several studies as the most abundant protein in microalgae. First a screening of the ILs available has been done, having into account that each IL is different and the behaviour in the ATPS can change. The first ATPS screening will be done investigating the stability of the protein and partition coefficient in the ATPSs. Since proteins are complex biomolecules, there are a lot of parameters that have an influence. Temperature, pH and

solvent concentrations will be evaluated in order to find the best environment for the protein. After understanding the behaviour of the model protein (Rubisco) in the IL-based systems, the other components will be evaluated. In order to develop the best extraction system for the components of the microalgae, studying performance of each component in the ATPS is essential.

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