FOOD & BIOBASED RESEARCH

WAGENINGEN UR

ALGAE BIOREFINERY: PROTEINS FOR TECHNICAL APPLICATIONS

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Background

The concept of biorefiney was mainly inspired from the petroleum refinery concept. It reflects a process to fractionate and valorise the biomass in order to enhance the value derived from each component present in the biomass and to maximise profitability. Microalgae are an excellent source of commodities like proteins, polysaccharides, lipids and pigments. Therefore, it is worthwhile endeavour to extract and fractionate these microalgal components in the framework of a biorefinery that respects the integrity of the components of interest.

Objective

In AlgaePARC Biorefinery program, the objective is to develop scalable unit operations for biorefinery of microalgal components. In order to preserve the functionalities of the commodities mild, inexpensive and low energy consumption techniques should be developed and applied. At Wageningen UR Food & Biobased Research one of the objectives is the isolation and fractionation of proteins from *Neochloris oleoabundans*.

Introduction

Microalgae have a large diversity of species in terms of composition and structural characteristics. Some species have very strong cell wall and others have very weak cell wall. The formers require a unit operation of cell disruption that will allow easy access to the intracellular valuable components such as proteins. For that purpose, different mechanical methods such as high-pressure homogenization, bead milling and pulsed electric field (PEF) were tested and evaluated for their efficiency in breaking the cell wall and releasing the intracellular components. The broken solution was then recovered and further fractionation of the released proteins was conducted using ultrafiltration or column chromatography. The advantage of ultrafiltration is that an enriched protein fraction could be obtained as it is being done at the dairy industries. Indeed, the determination of the optimal conditions for ultrafiltration is currently under investigation, and therefore the obtained fractions will be characterized, and their physico-chemical properties will be determined.

Results

- High-pressure homogenization and bead milling showed the highest release of proteins whereas PEF was not efficient.
- The high degree of disintegration of the cells was confirmed by microscopic observations for both high-pressure homogenization and bead milling. Both techniques were optimised and flow cytometry was used to measure the disintegration level.
- Comparison was made between the specific energy input/cell disruption efficiency.

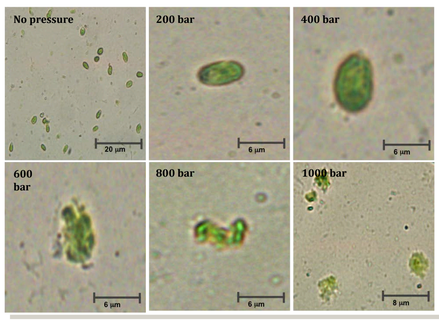
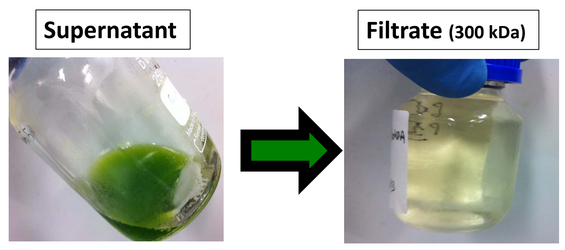


Figure 1. Microscopic observation of cells before and after high-pressure homogenization (Safi et al. 2014)

Results



- Chlorophyll was not detected in the filtrates
- Starch was completely retained by the membrane
- Proteins were highly concentrated in the filtrate

Figure 2. Schematic explanation of the overall process from cell disruption to the double step ultrafiltration

Conclusions

- Efficient cell disruption was achieved by either bead milling or homogenization
- Ultrafiltration was efficient to separate the hydrophilic molecules form each other

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