FOOD & BIOBASED RESEARCH

WAGENINGEN UR

ALGAE BIOREFINERY FOR NON-FOOD APPLICATIONS

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Background

Microalgae are among the most promising raw materials for chemicals. Their biomass is an excellent source of proteins, polysaccharides, lipids and pigments. These fractions can be used, apart from food and feed, for non-food applications such as binders in coating and adhesives, surface-active agents, green chemicals, bioplastics, plants fertilizer, and in the cosmetic and pharmaceutical industries.

Objective

In the EU-MIRACLES project the focus is on the development and integration of mild cell disruption and environmentally friendly extraction and fractionation processes, including functionality testing and product formulation based on established industrial algal strains. The project will also develop new technologies for optimizing and monitoring valuable products in the algal biomass during cultivation.

Introduction

At Wageningen UR Food & Biobased Research a (bio)chemical characterization of four industrial algae species, *Isochrysis galbana*, *Nannochloropsis gaditana*, *Phaeodactylum tricornutum* and *Scenedesmus obliquus* was performed. Dry matter content, ash weight, amino acid composition, protein content, oil/lipid content, fatty acid composition, sugar content, sugar composition and N-to-protein conversion factors were determined (Table 1). The main component was protein, with a similar total amino acid composition across the four species.

Results

Table 1. N-to-protein factors of the different algae species.

Algae	N-to-protein factor (Kjeldahl)
Isochrysis galbana	4.84
Nannochloropsis gaditana	4.84
Phaeodactylum tricornutum	3.95
Scenedesmus obliquus	5.20

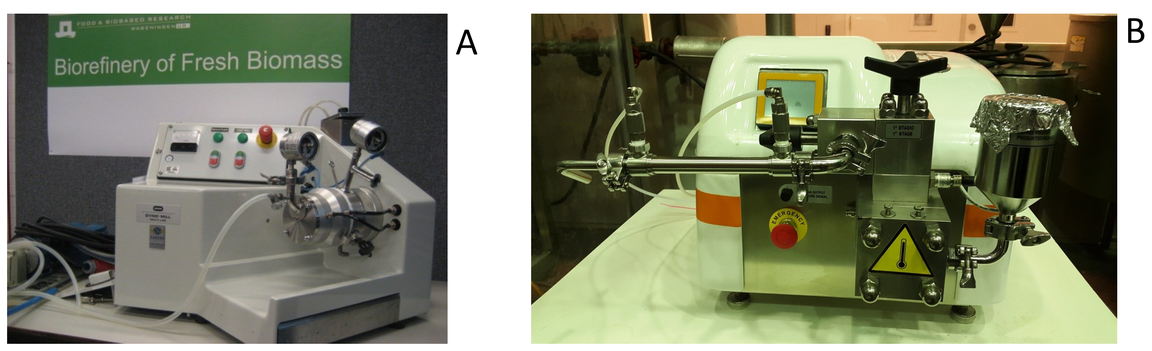

Figure 1. Bead mill (A) and high pressure homogenisator (B).

For cell disruption the mechanical methods bead milling (Figure 1A), high-pressure homogenization (Figure 1B), pulsed electric field (PEF) and calander treatment were tested and compared. Microscopic investigation indicated only total disintegration of the cells using high-pressure homogenization and bead milling. In addition the amount of proteins, saccharides and ions released was measured. Gel electrophoresis showed that there are differences in the composition of the released soluble proteins from the different algae. It turned out that disintegration is depending on the algae species structural characteristics, their growth stage and the way of storage.

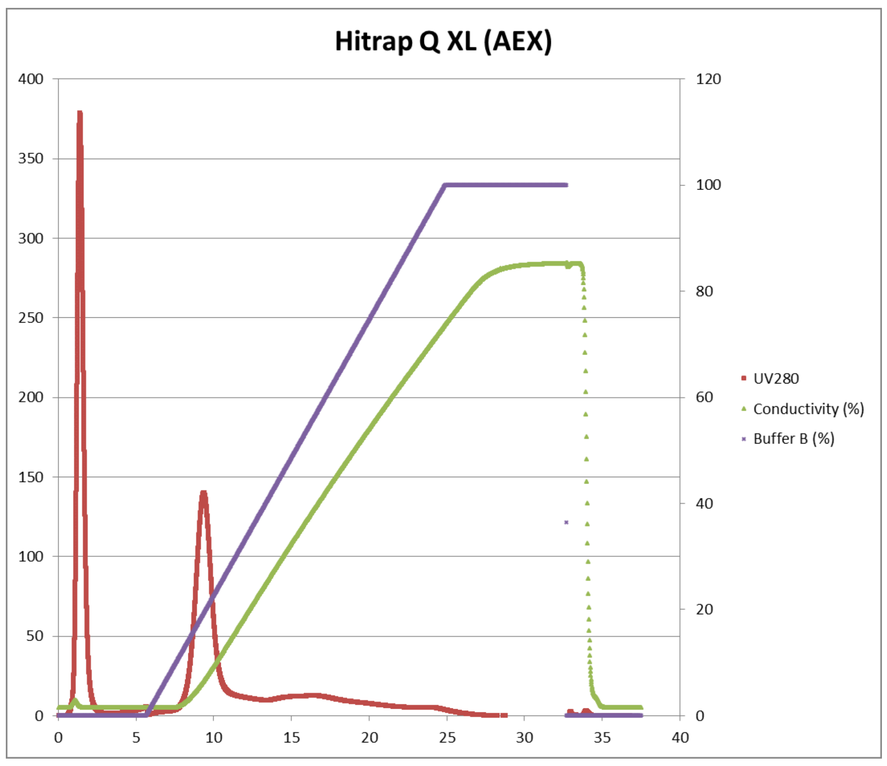

Figure 2. Anion exchange chromatography of proteins from *Isochrysis galbana*.

Further fractionation of the main components was studied using different techniques. Lipids were extracted using surfactants like secondary and tertiary amines. Proteins were fractionated by column chromatography (Figure 2) and (ultra)filtration. The fractions were characterized and their physico-chemical properties will be determined. The fractions will be tested by the industrial partners for their technical applications.

Conclusions

- Biochemical characterization was performed of 4 algae species
- Efficient cell disruption was achieved by either bead milling or high pressure homogenization
- Proteins, lipids and carbohydrates were separated in enriched fractions

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