WAGENINGEN
UNIVERSITY & RESEARCH

Nannochloropsis gaditana protein biorefinery

Carl Safi, Nicole Engelen-Smit, Lambertus A.M. van den Broek and Lolke Sijtsma

Abstract

Different cell disruption methods were tested on *Nannochloropsis gaditana*. For comparison high-pressure homogenization (HPH), bead milling, enzymatic treatment (protease) and pulsed electric field (PEF) were studied. Parameters taken into account were efficiency in terms of cell disintegration, energy input and release of proteins. Bead milling and HPH were the most efficient with respect to cell disintegration and release of protein. Both methods required low energy input like the enzymatic treatment. However, the proteases released less protein. Under the conditions studied PEF was neither energy-efficient and effective in cell disintegration. In addition it was not successful for protein release. The energy cost per unit or released protein using HPH was between 0.15-0.25 Euro per kg protein [1].

The aim was to obtain an enriched fraction of water soluble proteins free from chlorophyll. About 50% of the total proteins was released in the aqueous phase using HPH. Incubating *N. gaditana* only with Alcalase (a protease) without HPH treatment resulted in release of 35% of the total protein. Both soluble protein fractions were subjected to ultrafiltration/diafiltration (UF/DF). Membranes with different cut-off, ranging from 300 to 1,000 kDa, were tested. After optimizing the process conditions the combination of enzymatic treatment and UF/DF resulted in a larger overall yield of water soluble proteins (25%) then using HPH and UF/DF (17%). In both cases a chlorophyll free solution was obtained [2].

Results

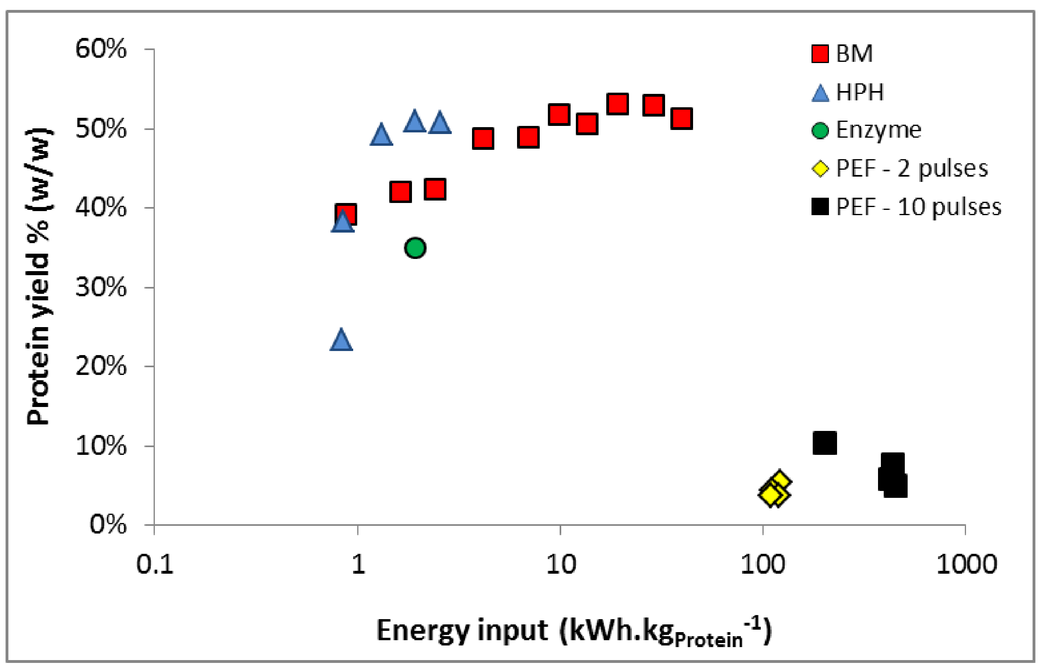

Figure 1. Overall comparison between all cell disruption methods tested with *Nannochloropsis gaditana*. The results shown represent the protein yield and the specific energy input. BM is bead milling, HPH is high pressure homogenization, PEF is pulsed electric field.

Results

Figure 2. Schematic representation of the overall process from cell disruption to diafiltration.

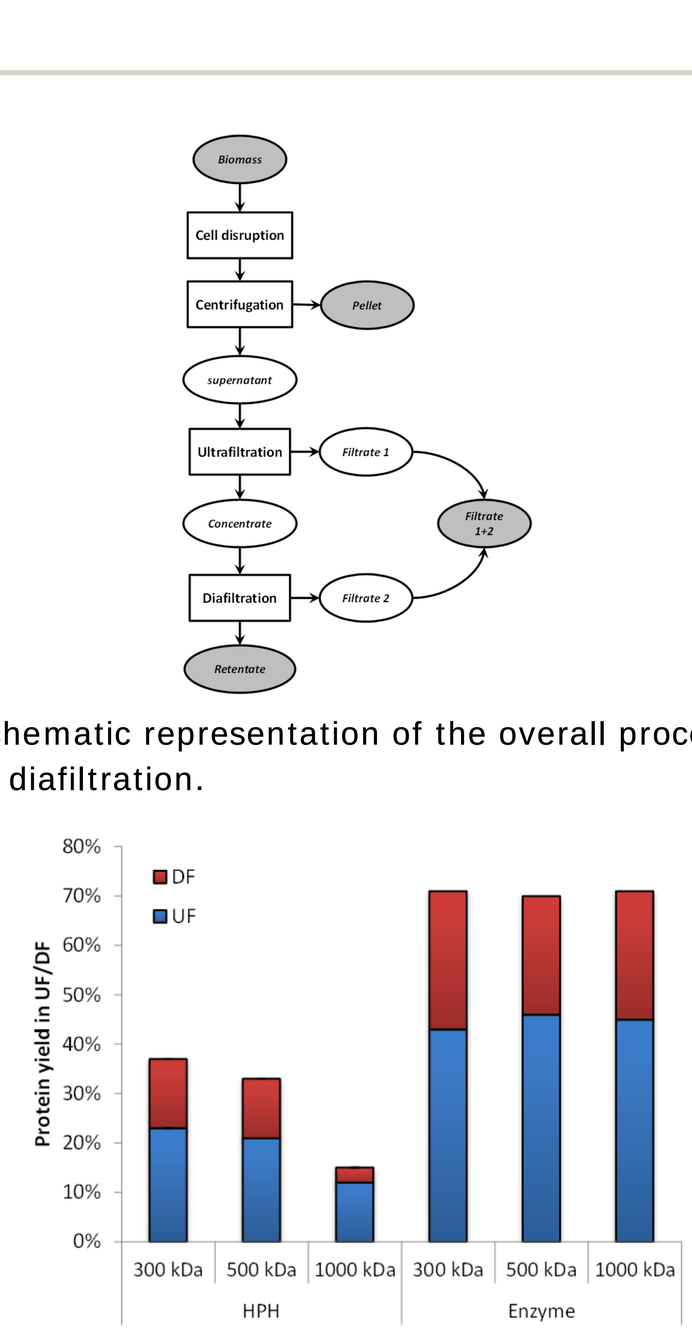

Figure 3. Recovery of *Nannochloropsis gaditana* proteins in the filtrate after a two-step filtration using membranes with different molecular weight and after two cell disruption methods. DF is diafiltration and UF is ultrafiltration, HPH is high pressure homogenization, Enzyme is protease treatment. Protein yield is expressed as % (w/w) of soluble proteins in the supernatant after the cell disruption method.

References

1. Safi C, Cabas Rodriguez L, Mulder WJ, Engelen-Smit N, Spekking W, Van den Broek LAM, Olivieri G, Sijtsma L (2017) Energy consumption and water-soluble protein release by cell wall disruption of *Nannochloropsis gaditana*. Bioresour Tech 239:204-210.
2. Safi C, Olivieri G, Campos RP, Engelen-Smit N, Mulder WJ, Van den Broek LAM, Sijtsma L (2017) Biorefinery of microalgal soluble proteins by sequential processing and membrane filtration. Bioresour Tech 225:151-158.

Acknowledgements

This research was carried out within the EU MIRACLES project (European Union's Seventh Framework program, Grant agreement No 613588).

Wageningen Food & Biobased Research
P.O. Box 17, 6700 AA Wageningen, The Netherlands
Contact: Carl.safi@wur.nl
T + 31 (0)317 48 09 70
www.wur.nl/fbr