DISRUPTION OF SCENEDESMUS AND OTHER MICROALGAE CELLS: IMPACT OF DISRUPTION APPROACH AND ALGAE BIOMASS PRESERVATION PRIOR TO DISRUPTION

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Introduction

Microalgae are a potential source of a variety of compounds like fatty acids, proteins, sugars, carotenoids and colorants. To make the intracellular compounds accessible, the cells need to be disrupted, which might be challenging as some algae species have strong cell walls.

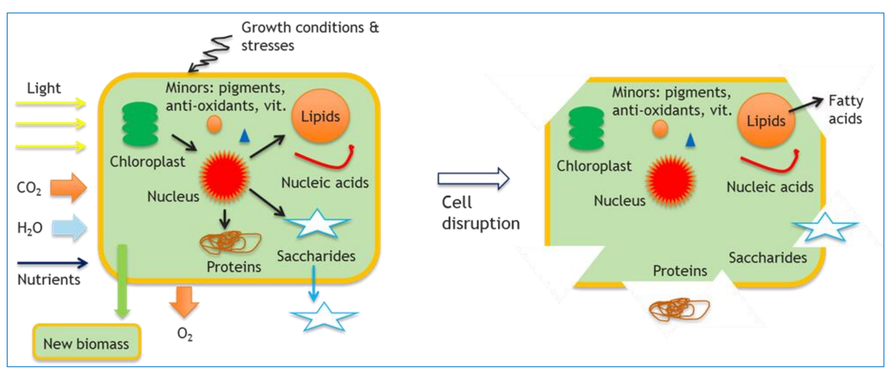

Figure 1: schematic representation of cell disruption of algal cells.

Aim:

- Evaluation of cell disruption on algae species level using beadmilling.
- Determination most suitable biomass preservation approach (fresh, frozen, freeze-dried) prior to the beadmilling.
- For *Scenedesmus sp.*: comparison of beadmilling and high pressure processing (HPP) as cell disruption approach.

Conclusions

- For all five microalgae species suitable cell disruption approaches could be selected that resulted in at least 33 % of cell disruption (% OM solubilized).
- Freezedrying was found rather sufficient for *P. purpureum*, while beadmilling was required for other algae species, especially *Nannochloropsis* sp. and *Scenedesmus sp.* HPP was less efficient.
- Beadmilling on fresh algae biomass is preferred (high % disruption, to avoid additional drying/freezing), especially for *Scenedesmus* sp.
- Beadmilling was found suitable for treating larger algae quantities.

Cell disruption of microalgae using beadmilling

Set-up

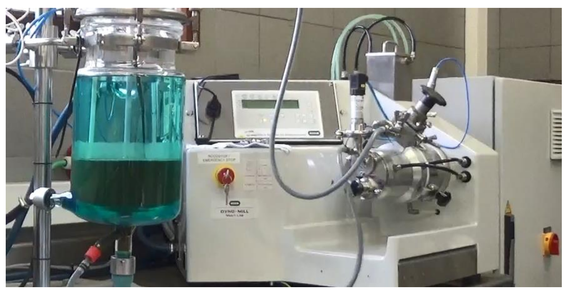

Figure 2: Beadmill set-up.

- Beadmilling with 4L cooled recirculation reservoir.
- Algae biomass 3-15 % DM
- Exposure time = 4-7 min
- Organic matter (OM) based degree of cell disruption (determined at pH8) =

$$\frac{\text{OM in supernatants} * 100}{\text{OM in total}}$$

Results

The impact of the cell disruption process was evaluated by quantifying the amount of the water soluble and non-soluble compounds. The degree of cell disruption before and after beadmilling is summarize in table 1 for five algae species and three different algae biomass preservation approaches. Preferred approaches are indicated with a black rectangular.

Table 1: Cell disruption degree (%) of fresh, frozen and freeze-dried algae biomass of 5 microalgae species.

Algae species	Fresh algae		Frozen algae		Freeze-dried algae	
	Before	After	Before	After	Before	After
Nannochloropsis saline **	2 %	37 %	12 %	33 %	13%	39 %
Nannochloropsis gaditana *	2-8 %	47-55 %	11 %	59 %		
Porphyridium purpureum *	11-12 %	28-33 %	22 %	29 %	19-26 %	29-31 %
Chloromonas typhlos *	31 %	47 %	45 %	51 %	31 %	35 %
Scenedesmus sp. **	4-6 %	35-57 %	24 %	43 %	16-23 %	22-41 %
Chlorella sp. **	10-14 %	50-70 %				

Algae biomass grown * in Sunbuilt (Thomas More/VITO, Belgium) and ** by Forschungszentrum Jülich (Germany). ** Mixed cultures dominated by one species.

Scenedesmus: comparison of beadmilling and High Pressure Processing (HPP)

As *Scenedesmus* sp. is a challenging strain in respect to cell disruption, two disruption technologies were applied and compared.

Cell disruption approaches

- Beadmilling: Cell disruption by intense physical contact between algal cells and beads.
- HPP: Cell disruption by pressure and decompressing.
- *Scenedesmus* biomass:
  - fresh biomass (14% DM)
  - Freeze-dried biomass stored prior at -20°C & -80°C (11-12 % DM)

Results

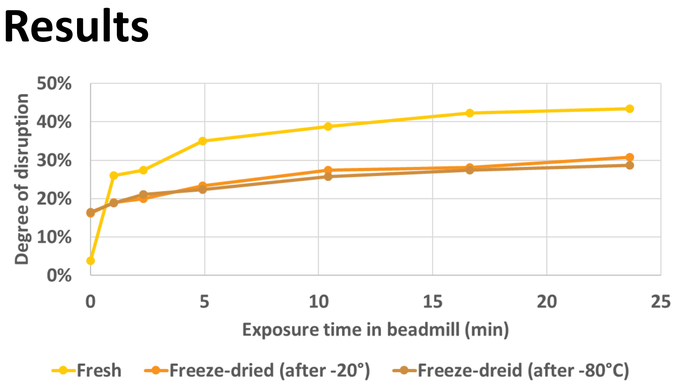

Figure 3: OM based degree of cell disruption of *Scenedesmus* sp. Impact is highest on fresh algae biomass.

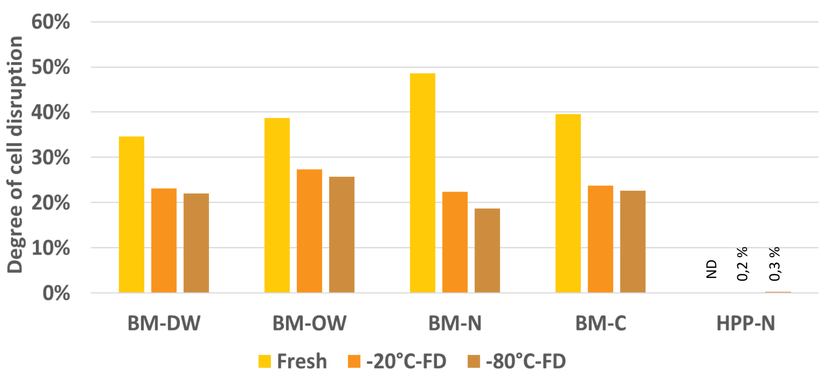

Figure 4: Degree of cell disruption of *based on dry weight (DW), organic matter (OM), nitrogen (N) and Carbon (C) as obtained by beadmilling (BM) and HPP.*

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