



Deep Eutectic Solvents as a novel extraction system for microalgae

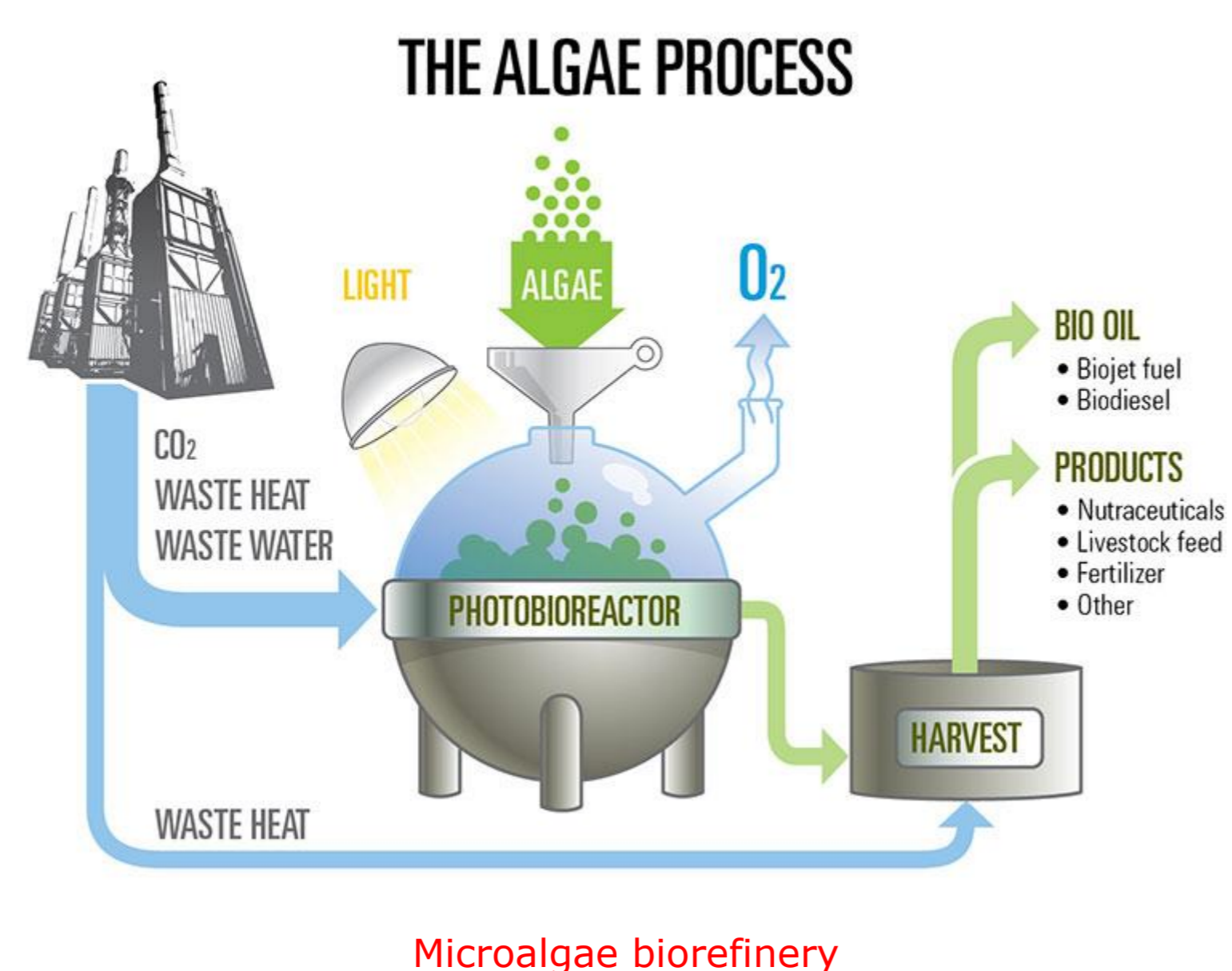
Calvin Lo, Michel H.M. Eppink, René H. Wijffels, Corjan van den Berg

Wageningen University, Bioprocess Engineering, P.O. Box 16, 6700 AA, Wageningen, The Netherlands

Background

Microalgae biorefinery is an emerging concept for complete valorisation of microalgae biomass. However, current DSP techniques for microalgae involve harsh conditions, causing major loss of protein functionality. Ionic liquids, a mild alternative solvent for microalgae, tend to be fossil-based, expensive, non-biodegradable and toxic.

Deep eutectic solvent (DES), a new class of melts, are gaining interest as a *green* and cheap version of ionic liquids. DES offer more flexibility in tuning its physicochemical properties. These solvents have been also used for extraction of lignocellulosic biomass and bioactive compounds, but never been applied on microalgae. Despite that, high viscosity and unsuccessful back-extraction hinder the application of DES.

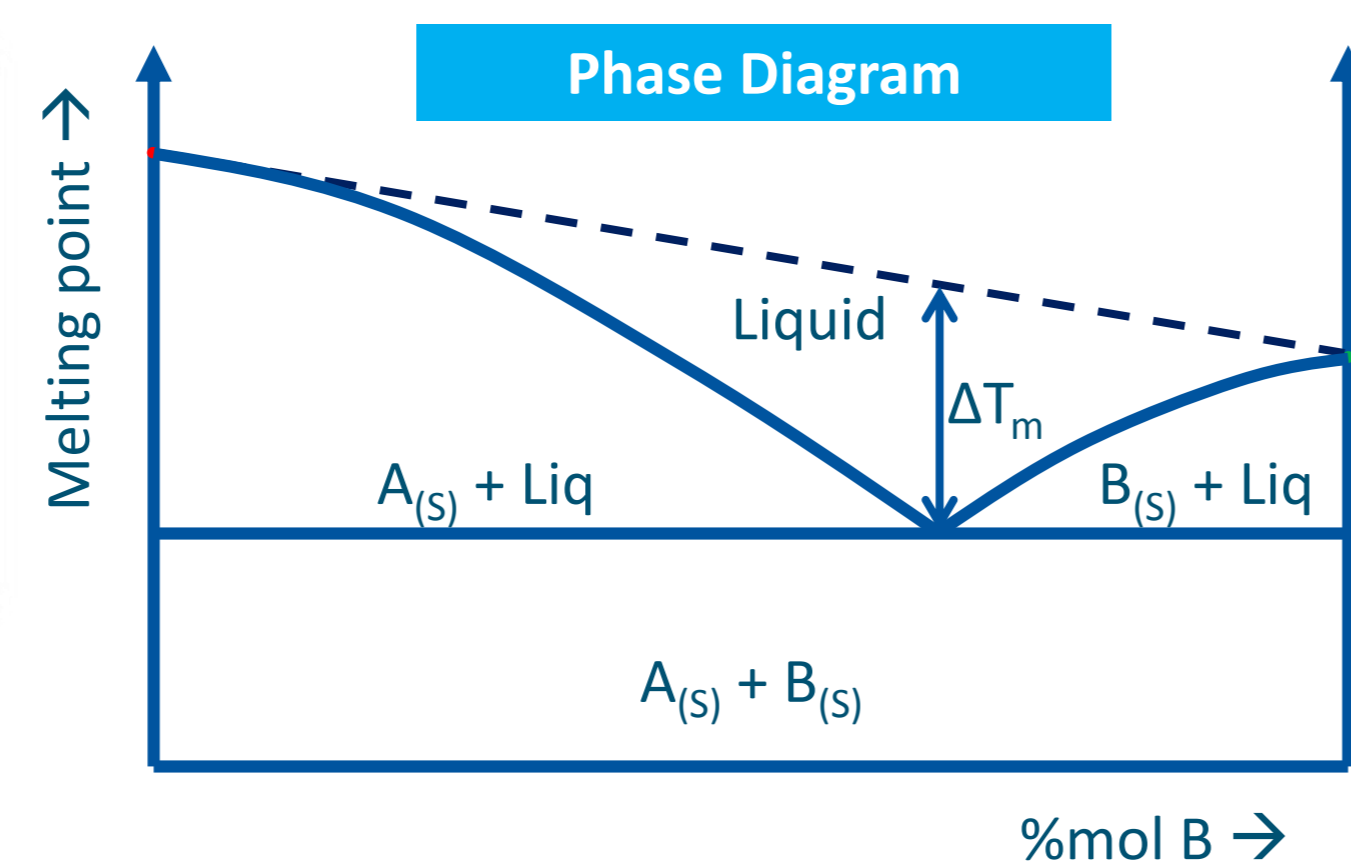


What are deep eutectic solvents?

- Eutectic mixture of 2 (or more) compounds instead of ion pairs.
- Formed by self-association via hydrogen bonding.
- Easy preparation from renewable starting materials.



Left to right:
Sucrose, fructose, glucose, malic acid, Suc:Fru:Glc (1:1:1), Suc:Mal (1:1) from (Choi et al, 2011)



Objective

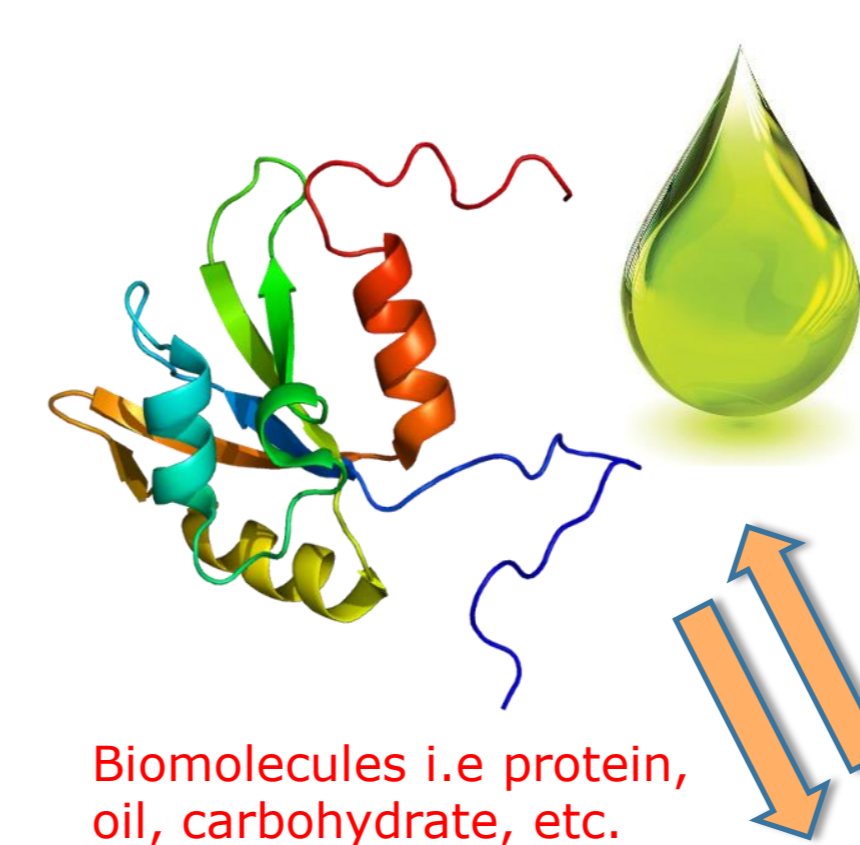
- **Screening** of suitable DES for extraction of biomolecules.
- Developing **back-extraction** strategy for deep eutectic solvents.
- Investigating **effect of DES** on algae cell wall and components.
- Understanding the governing principles of DES **physicochemistry**.
- **Designing** DES-based extraction system for microalgae.

Acknowledgements

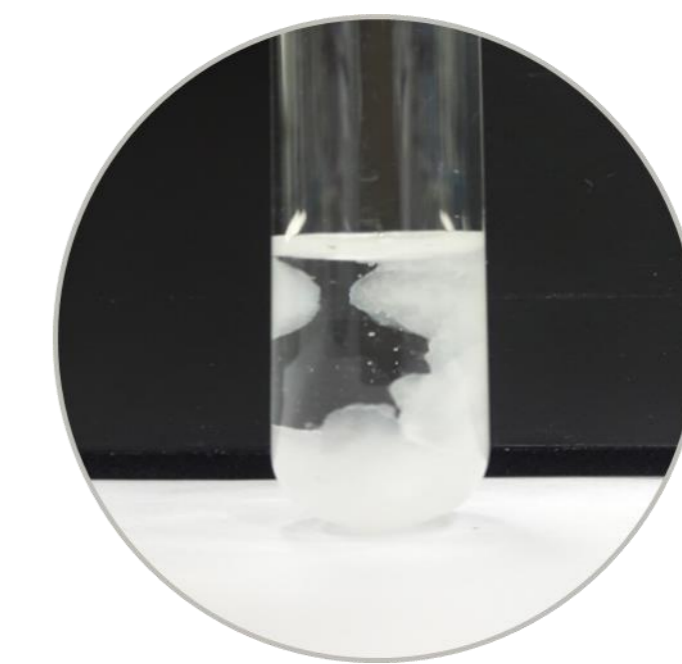
The authors would like to thank Bio-Based Industries Joint Undertaking (BBI-JU) for funding this research included in the European project MAGNIFICENT.

Approach

I. Extraction and back-extraction



- **Screening** of deep eutectic solvents
- **Solubility** of model compounds
- Effect of solutes on phase diagram
- Effect of change in **T-, pH-, pressure-, ionic strength-, or composition** on solubility

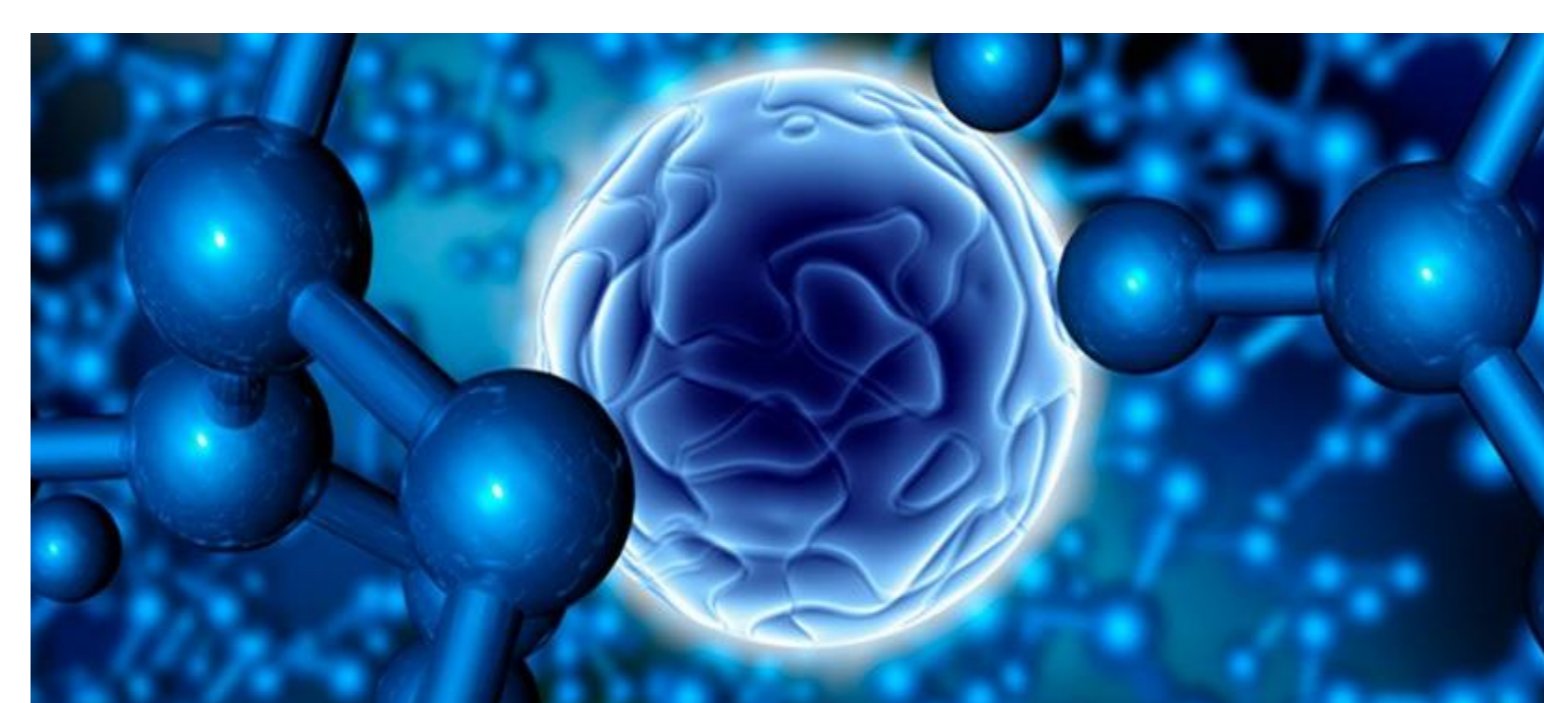


II. DES-based microalgae extraction

- Effect of DES on microalgal **cell wall**
- Extraction **yield and selectivity**



III. Tailoring physicochemical properties of DES



- Correlation between molecular interaction and **physicochemical properties**

IV. Extraction system design

- **Diffusivities** of biomolecules in DES
- **Non-ideal** behaviour of DES
- Design extractor to improve **mass transfer**
- Performance & **techno-economic** analysis

