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entirely on eutectic solvents**

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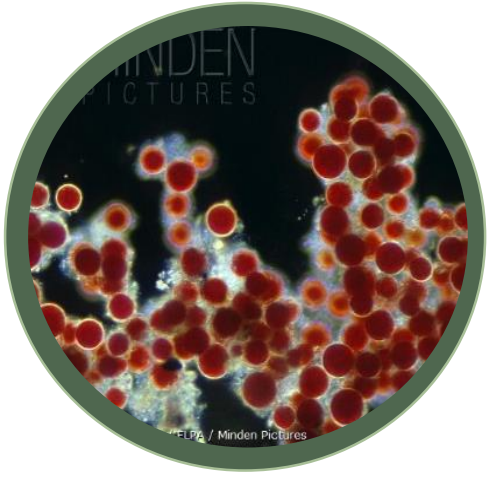
Porphyridium cruentum as a chemical factory: valorization of high-value phycobiliproteins and lipids using an innovative solid-liquid-liquid method based entirely on eutectic solvents.

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Introduction



Porphyridium cruentum, a red microalgae, is a valuable source of metabolites with high added value, such as **free fatty acids** and pigments like **phycobiliproteins**, with pharmaceutical, cosmetics, and nutraceutical effects.



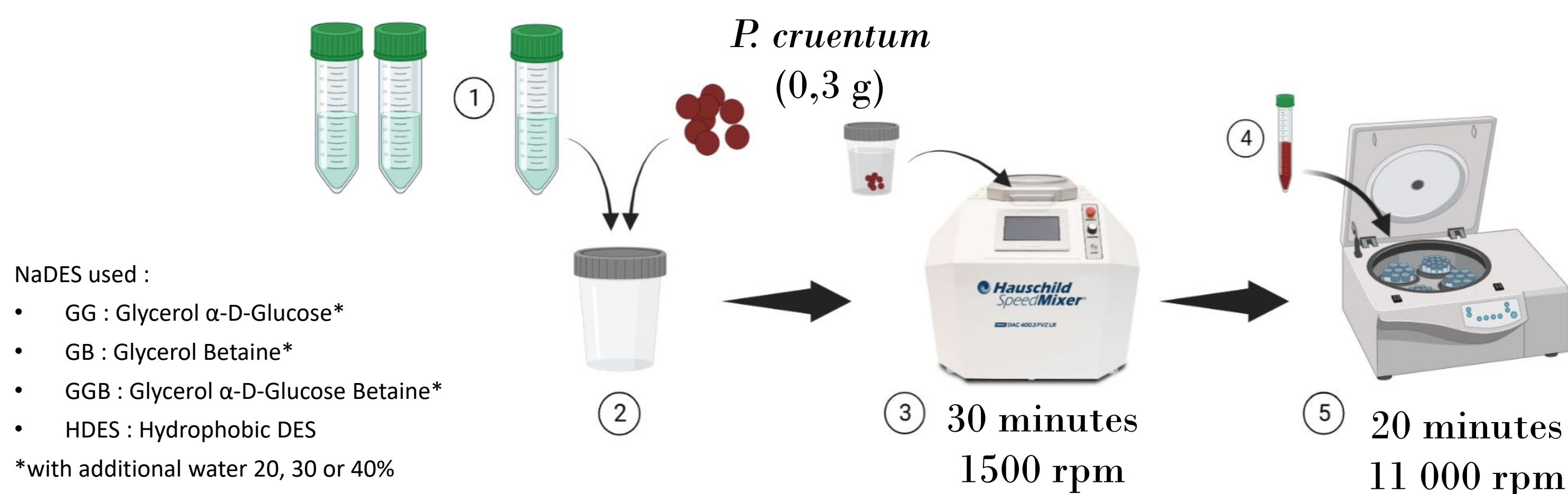
Natural Deep Eutectic Solvents (NaDES) are a new environmentally friendly substitute for petrochemical solvents. NaDES are green, non-toxic, economical, and **bio-based solvents** formed from plant metabolites such as sugars¹.



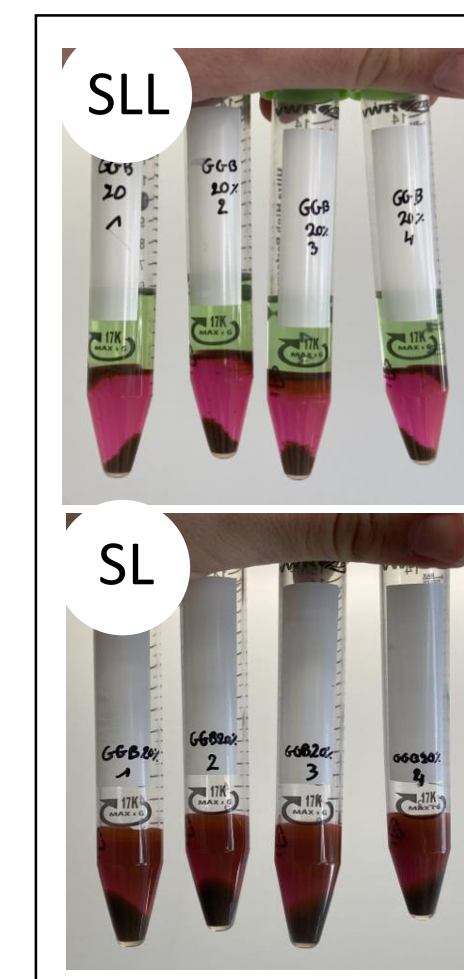
Development of an innovative solid/liquid/liquid (SLL) strategy for **one-step extraction and purification** of metabolites using a combination of polar and non polar NaDES².

Workflow

One or two different NaDES (3g each)



Recovered extracts



UV/Vis



Pigments



LC-ESI-MS



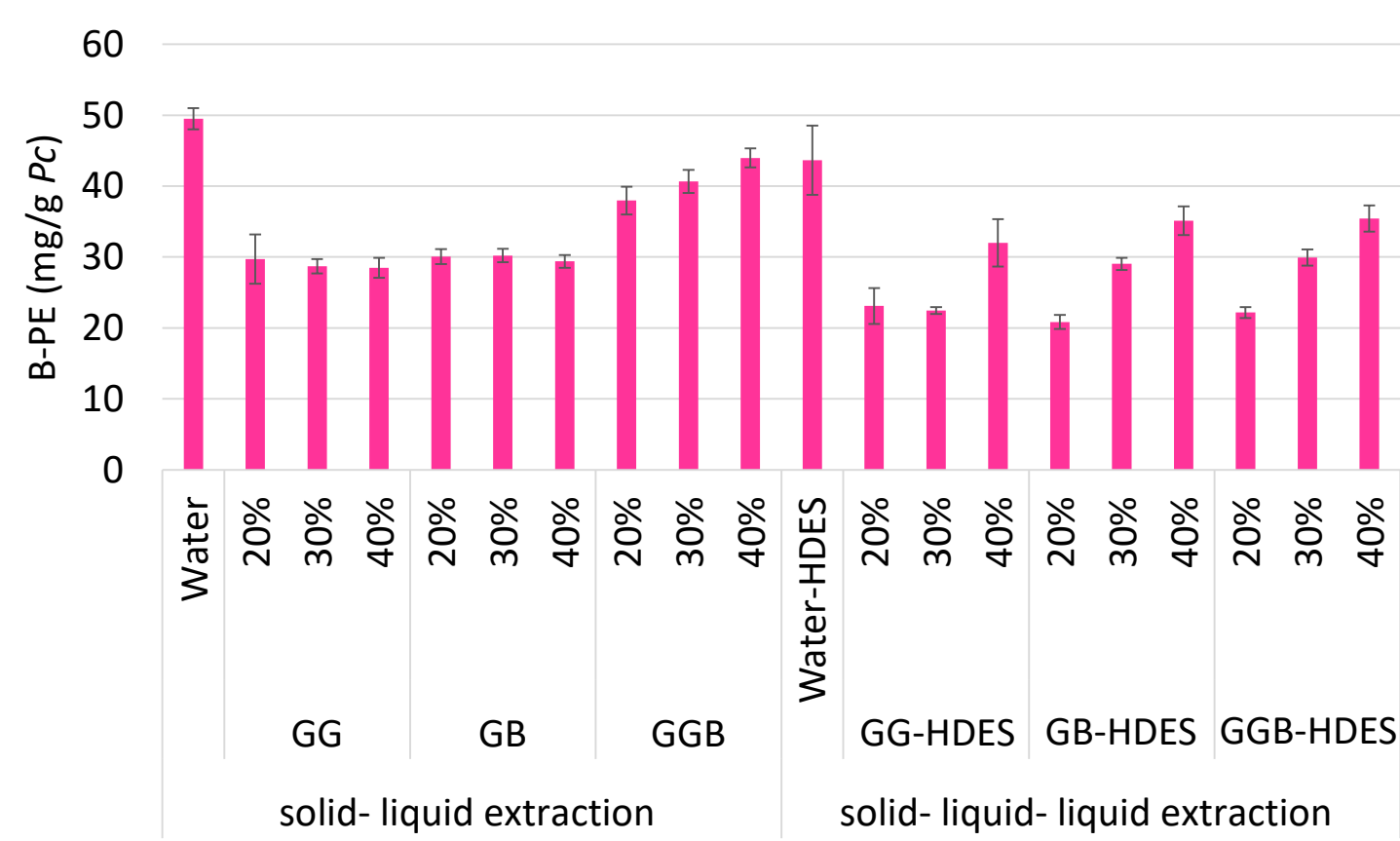
Lipids



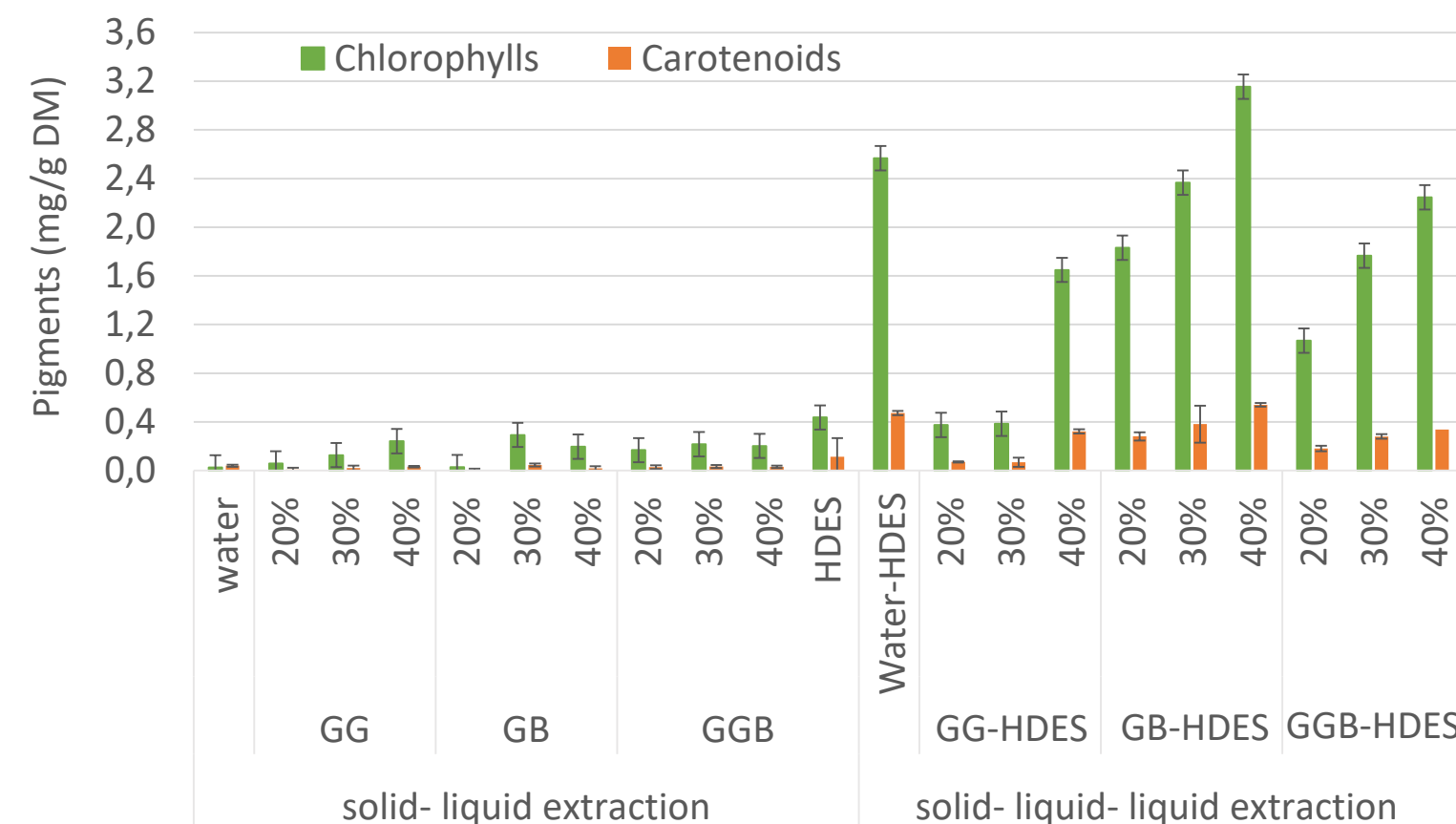
Results

Pigments recovery

Quantity of B-PE extracted (mg/g DM)



Chlorophylls and carotenoids extracted (mg/g DM)

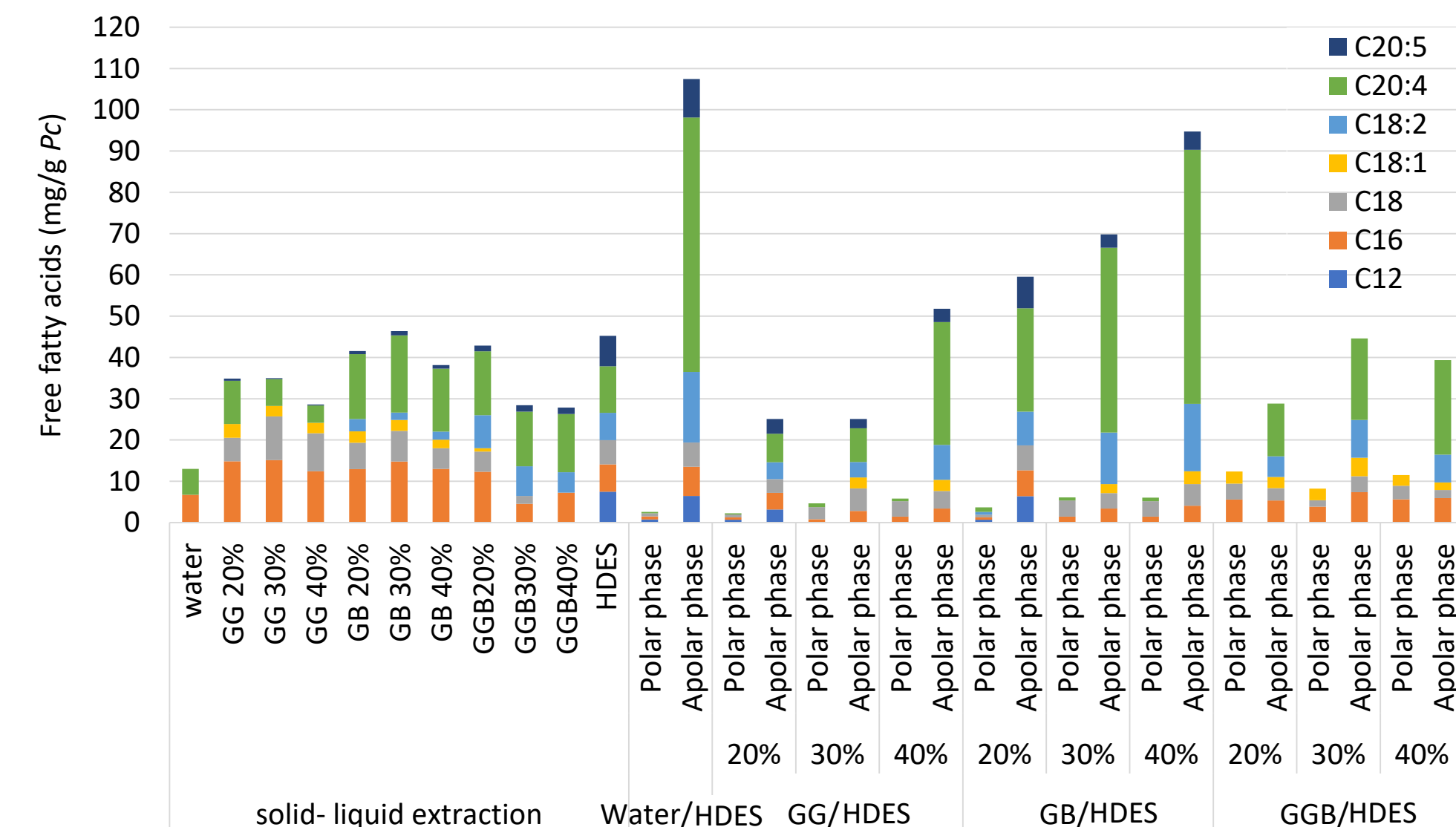


- ✓ SL : GGB best skills
- ✓ SLL : NaDES with 40% of water are the best for B-PE extractions

- ✓ SL : Non polar NaDES alone has poor abilities (HDES)
- ✓ SLL : promotes the access to non polar metabolites
- ✓ GB40%-HDES is the best couple in hydrophobic pigments extraction

Free Fatty Acids recovery

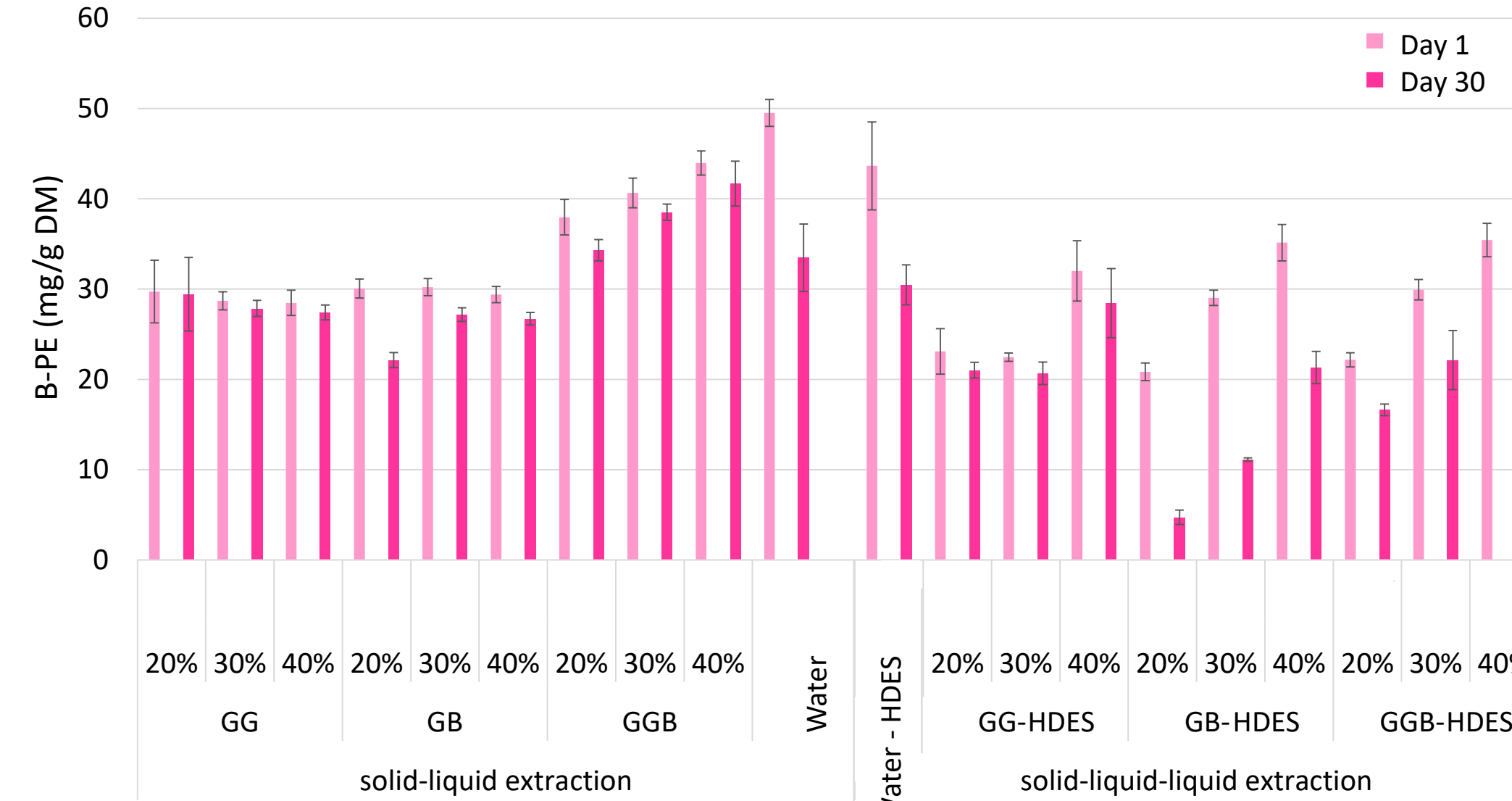
FFA profile of NaDES extracts (mg/g Pc)



- ✓ SL : bad Performances
- ✓ SLL : Enhanced extraction using SLL strategy, GB most relevant NaDES

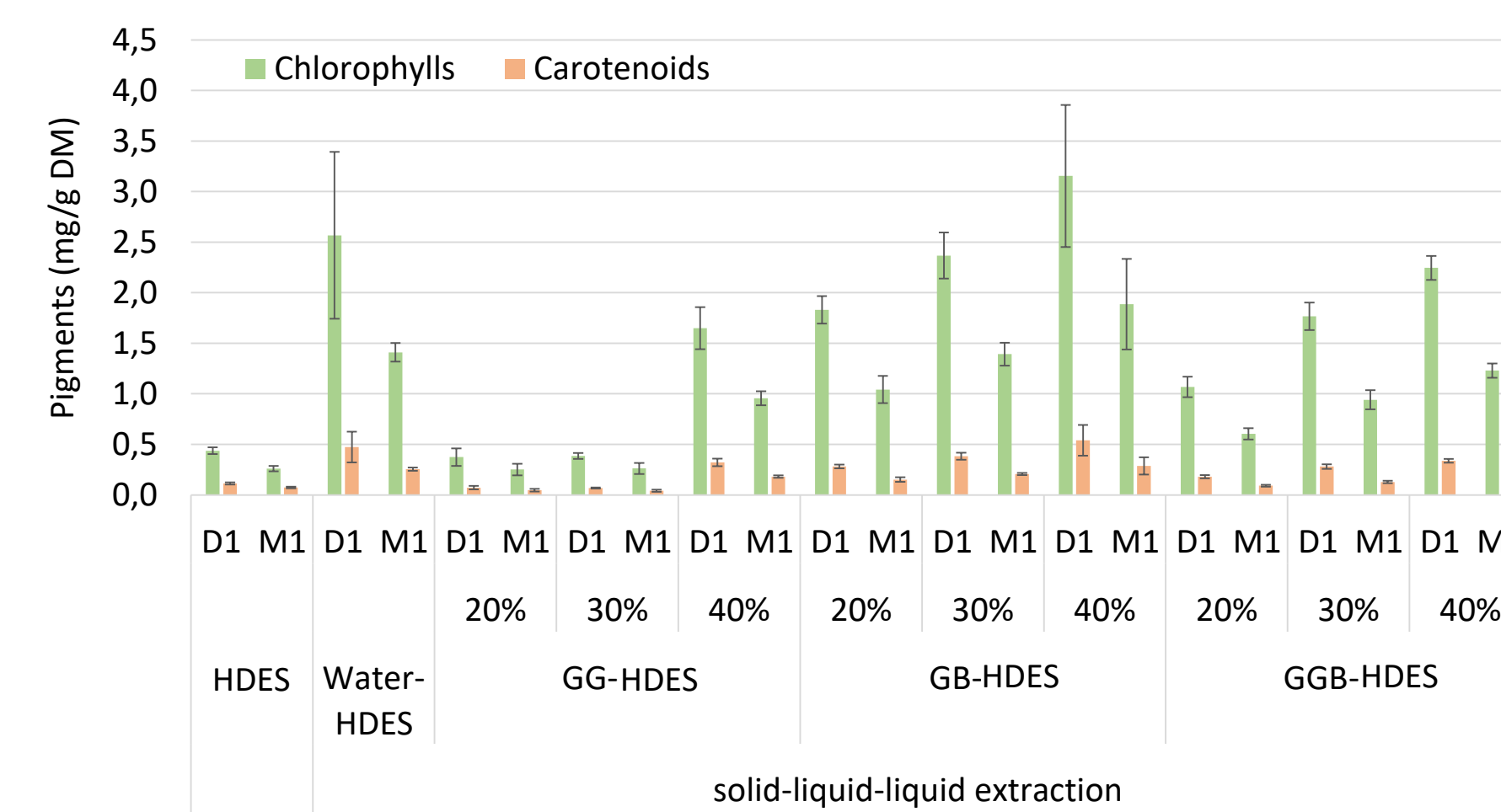
Pigments stability

Stability of extracts after 1 month



- ✓ SL : Enhanced stability in NaDES using SL process
- ✓ SLL : Good performances of SLL with GG

Stability of extracts after 1 month



Compound	Biomass total content
Phycocerythrin	54,7 mg/ g DM
Chlorophylls	3,0 mg/ g DM
Carotenoids	1,2 mg/ g DM

- ✓ SL : Poor stability using SL process
- ✓ SLL : Enhanced stability thanks to SLL strategy



- SL extraction are efficient for B-PE extraction and stabilization
- SLL strategy : interesting for non polar metabolites valorization (FFA, etc) and bright red color of B-PE extract

Conclusion

The optimal NaDES combination, as well as the preferred process (SL or SLL), is highly dependent on **the molecular target** and **the intended use of the extract**. For instance, if the objective is to achieve efficient extraction of chlorophylls and carotenoids while maintaining an adequate level of B-PE, the GB-40%/HDES combination is recommended. Conversely, if the objective is to ensure optimal conservation of the extracted B-PE, NaDES GG is the most effective.

Perspective

- Scale-up : ratio biomass - solvent 1/10 to a 1/5
- Transposing the SLL process to different technologies: microwave, ultrasounds
- Introduction of resulting extract in cosmetics

(1) Dai, Y., Witkamp, G.-J., Verpoorte, R., Choi, Y. H., 2013, Natural Deep Eutectic Solvents as a New Extraction Media for Phenolic Metabolites in Carthamus tinctorius L. Anal. Chem. 85, 6272–6278.

(2) Hilali, S., Van Gheluwe, L., Yagmur, M., Wils, L., Phelippe, M., Clément-Larosière, B., Montigny, B., Jacquemin, J., Thiery, E., Boudesocque-Delaye, L., 2024, NaDES-based biorefinery of Spirulina (Arthrospira platensis): A new path for sustainable high value-added metabolites. Sep. Purif. Technol. 329, 125123

