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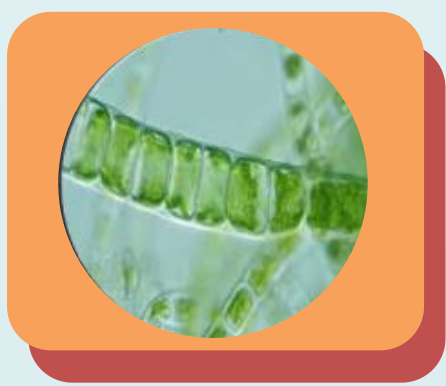
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Impact of biomass hydration on the valorization of nonpolar metabolites from Spirulina using eutectic solvents

Mervé Yagmur^{a,*}, Alia Chevalley^b, Bénédicte Montigny^c, Johan Jacquemin^d and Leslie Boudesocque-Delaye^a

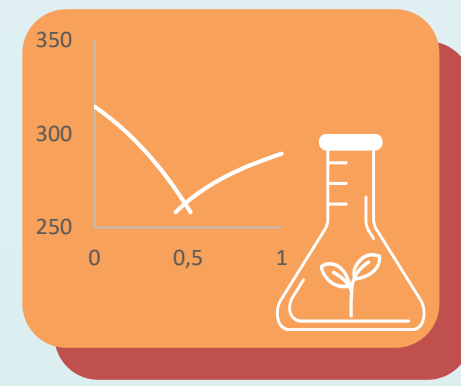
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Introduction



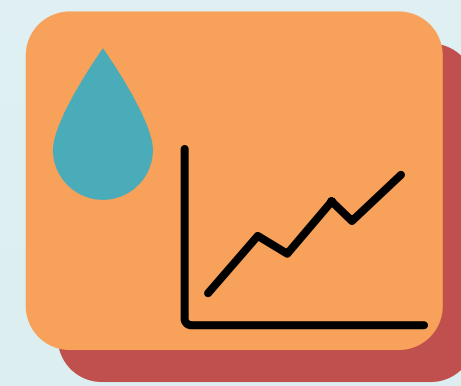
Arthrospira platensis

Microalgae like Spirulina are a valuable source of biomolecules, including **free fatty acids (FFA)** presenting anti-inflammatory, moisturizing and regulating properties, highly valued in the cosmetic industry.¹



Natural Deep Eutectic Solvents (NaDES) as green alternatives for Spirulina extraction: bio-based solvents made from two or more compounds found in plant primary metabolites.²

- Easy to prepare
- Nonvolatile
- Biodegradable

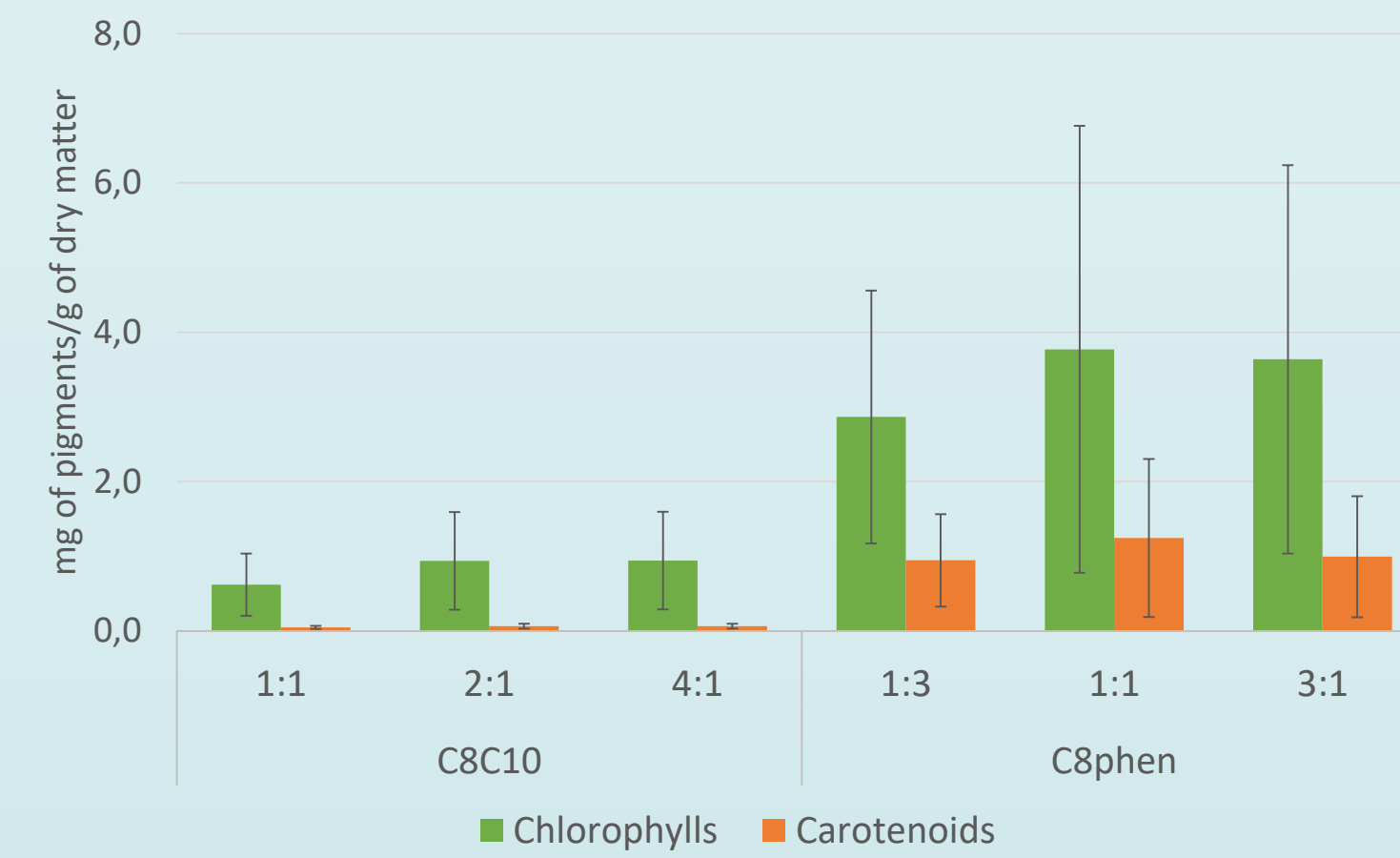


Spirulina, a water-rich biomass

Water impact? What parameters can optimize and facilitate extraction for a potential scaling up?

Fresh biomass

Lack of consistency in experimental results



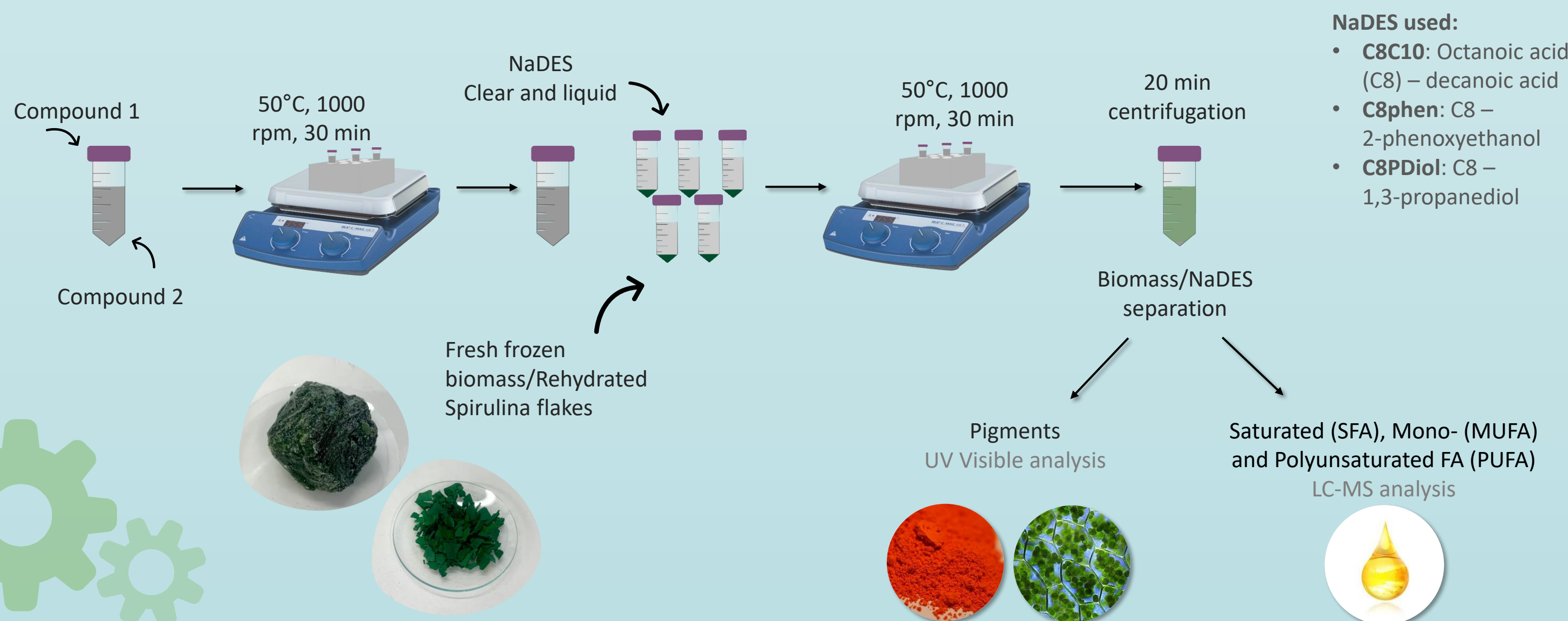
The initial analyses of the fresh biomass revealed results that were not highly reproducible, with **significant errors** in the tested ratios attributed to **biomass degradation**.

Alternative: using easily manageable biomass → Flakes

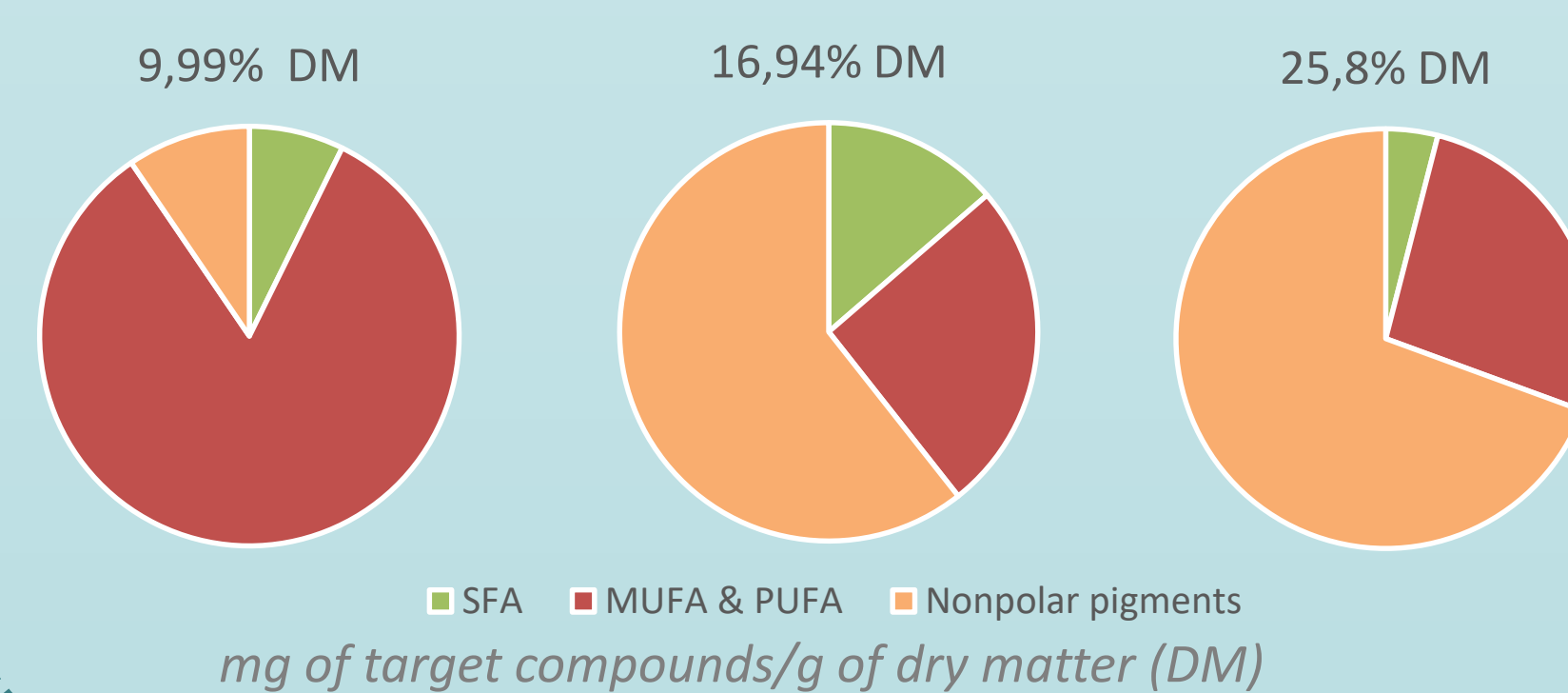
Freshly thawed biomass
Intact spirulina filaments
→ limited accessibility

Biomass subjected to multiple freeze-thaw cycles: degraded filaments
→ ease of accessibility

From biomass to NaDES extract



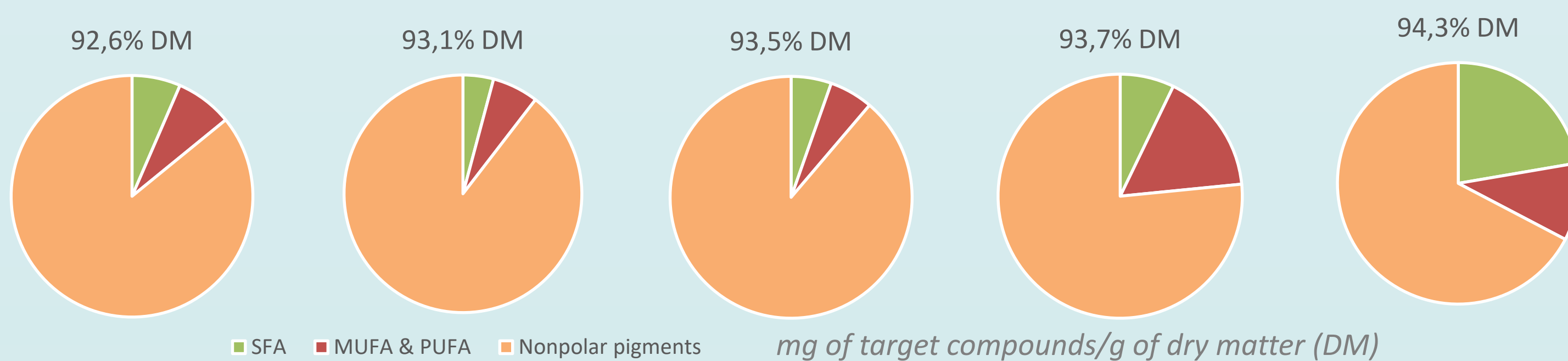
Inter-batch variability



- Significant variability among batches
- Challenges in developing a robust extraction model

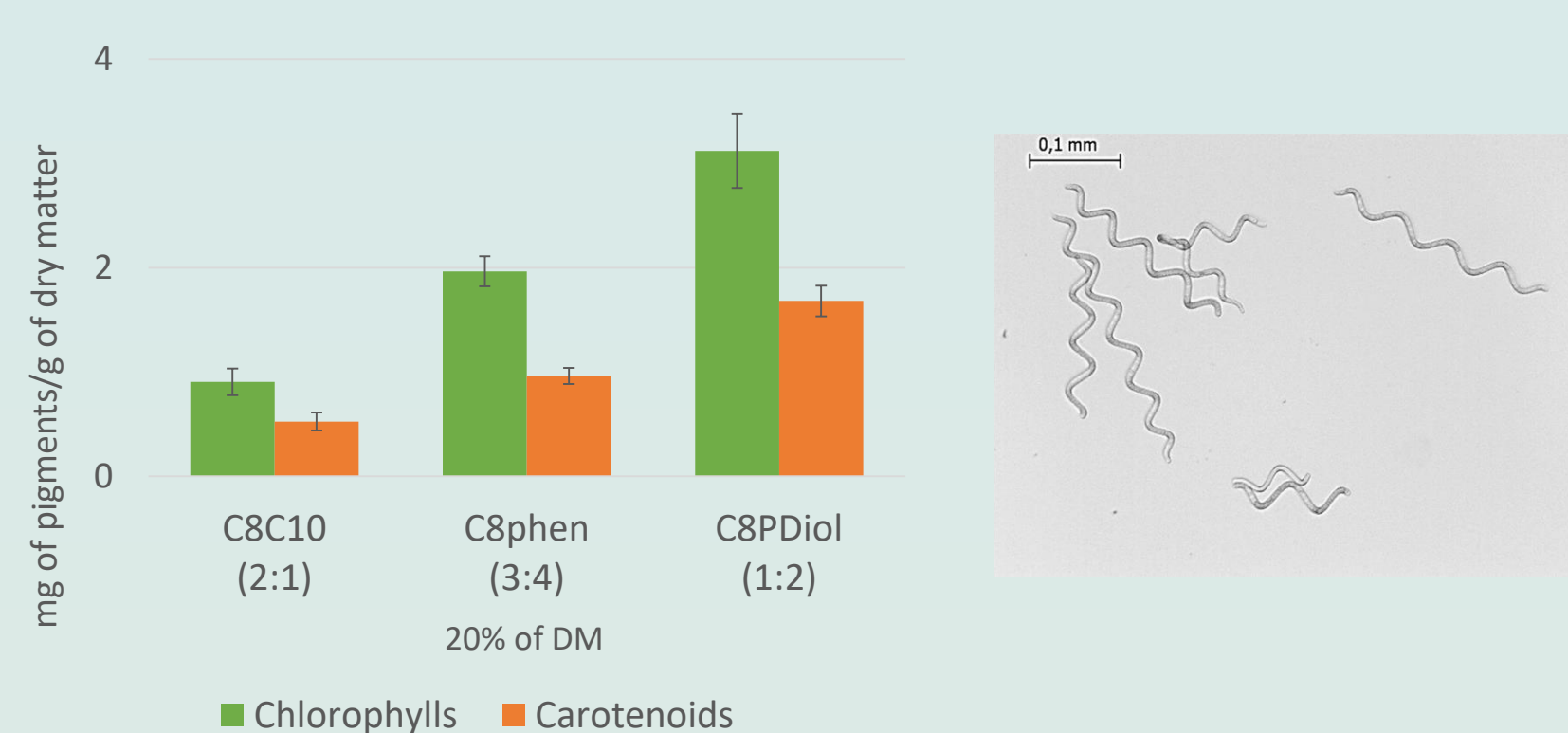
Flakes

Reduced inter-batch variability



- Reduced inter-batch variability for flakes, in contrast with fresh biomass
- Ease of biomass handling and possibility to establish an extraction model for potential scaling up

Reproducibility of data with rehydrated flakes



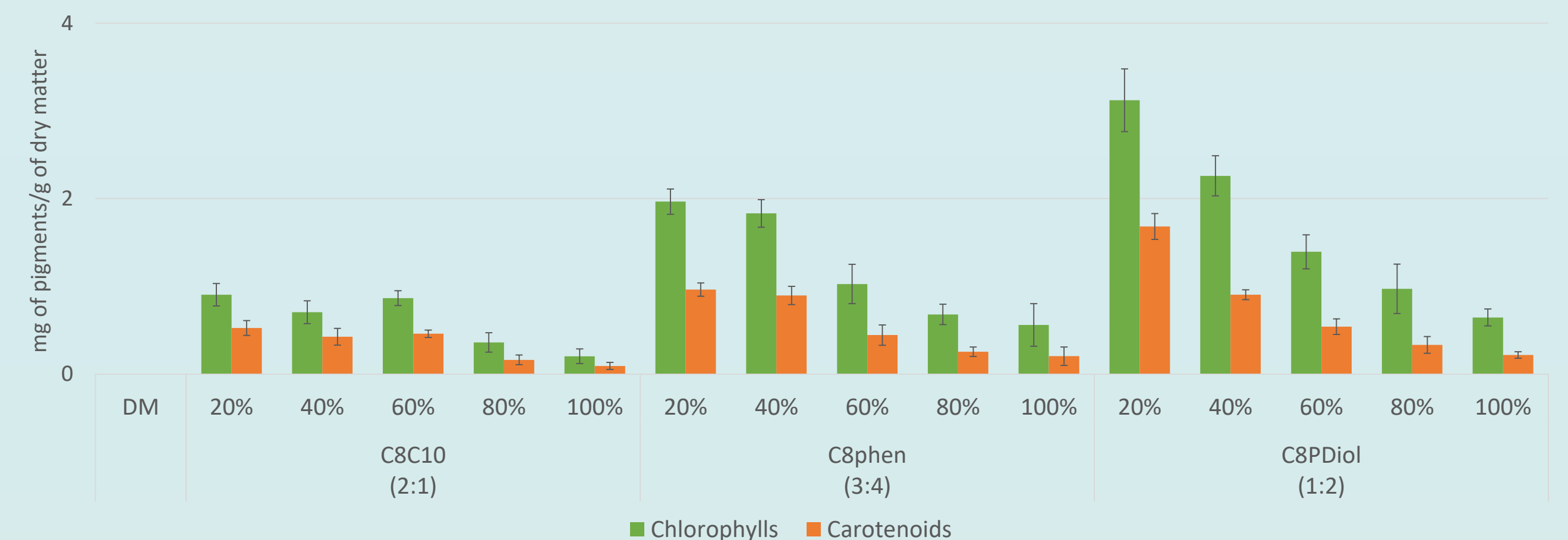
Spirulina flakes

- ✓ Intact spirulina filaments
- ✓ No impact on biomass structure and stability over time

- Despite reduced extractability compared to fresh biomass, flakes have been identified as a more practical option due to the reproducibility of results and their stability over time.
- Does the water content of the medium influence the final extract?

Effect of the rehydration rate on NaDES extracts

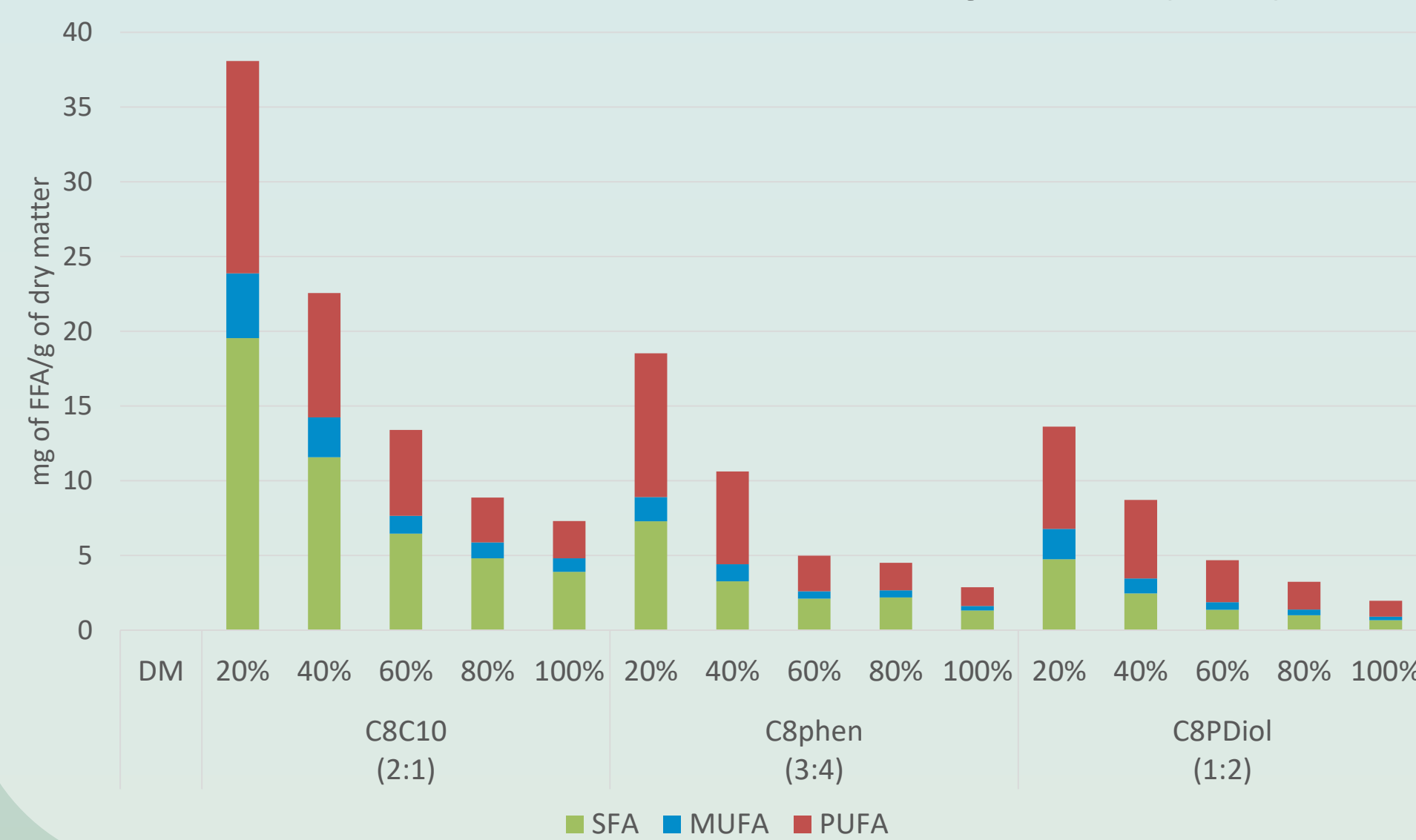
Nonpolar pigments recovery



The water impact was studied from 20% to 100% DM content:

- A negative correlation was found between the degree of biomass hydration and pigment levels for C8phen and C8PDiol (NaDES with intermediate polarity)
- C8C10 exhibited a plateau between 20% and 60% DM content.

Free Fatty Acids (FFA) recovery



- The rehydration rate appears to generally induce a decrease in pigment and FA levels, including SFA, MUFA and PUFA.
- Accordingly, the rate can be adjusted as needed.

Conclusions and perspectives

Fresh frozen Spirulina biomass

- Good extraction capability
- Poor shelf life leading to divergent results
- Variable inter-batch composition

Spirulina flakes

- Good shelf life
- Long-term stability
- Lower extraction capacity
- but easier extraction and potential scalability

- A rehydrated biomass generally exhibits higher extractability compared to a dry biomass
- Water in the medium appears to enhance extractive capacity

Perspectives

- Study water behavior with NaDES
- Implement in other extraction processes
- Scale up under optimal conditions

¹ Desbois, A. P., & Smith, V. J. (2010). Antibacterial free fatty acids: Activities, mechanisms of action and biotechnological potential. Applied Microbiology and Biotechnology (Vol. 85, Issue 6, pp. 1629–1642).

² Dai, Y., van Spronsen, J., Witkamp, G. J., Verpoorte, R., & Choi, Y. H. (2013). Natural deep eutectic solvents as new potential media for green technology. Analytica Chimica Acta, 766, 61–68.

