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NaDES for valorization of phycobiliprotein extraction co-products : free fatty acids as high added value biocompounds

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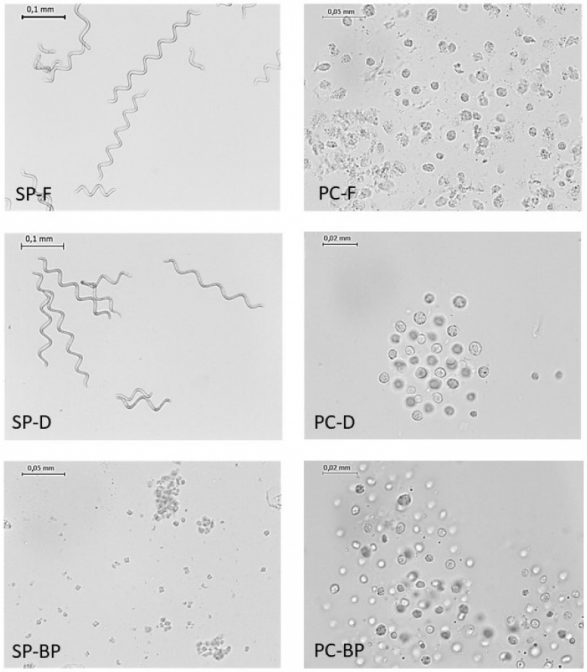
PURPOSE OF THE ABSTRACT

Spirulina (Arthrospira platensis) and Porphyridium cruentum are intensely studied because of their high content of phycobiliproteins, original antioxidant pigments. The growing demand for products concentrated in phycobiliproteins has led to an exponential increase in the production of extraction by-products, highlighting the need to develop a biorefinery approach to valorize this waste. In particular, the non-polar metabolites present within these by-products, such as lipids or carotenoids, are also recoverable. Among them, free fatty acids (FFA), commonly considered as an indicator of lipidome degradation, showed great potential for the cosmetic or nutraceutical markets. The main limitation to FFA beneficiation is the lack of sustainable extraction processes on the market. Natural deep eutectic solvents (NaDES) represent an innovative green alternative in this context. Our laboratory has already demonstrated the interest of these new green solvents for the extraction of FFA from Spirulina, from freeze-dried biomass.1 These first promising results led us to broaden our field of investigation by including, in addition to spirulina, Porphyridium (source of phycoerythrin), as well as several pre-treatment of biomasses: dried, frozen, frozen/lyophilized, and a by-product of the aqueous extraction of phycobiliproteins. The extraction performances of biobased solvents as well as apolar NaDES were compared. The impact on the integrity of the biomass, the recovery and the profile of the FFAs were studied by microscopy and LC-ESI-MS. NaDES based on fatty acids were highlighted as the most promising for recovering FFAs from microalgae, regardless of the pretreatment, with high selectivity towards saturated FFAs. The presence of polyols within the NaDES modulates the selectivity and redirects it in favor of the polyunsaturated fatty acids. Prior extraction of phycobiliproteins has proven to be the best pretreatment for FFA recovery, due to its impact on cell integrity. These data pave the way for the design of a multi-stage microalgae biorefinery scheme using NaDES or sustainable solvents for the cosmetic or food industry.

FIGURES



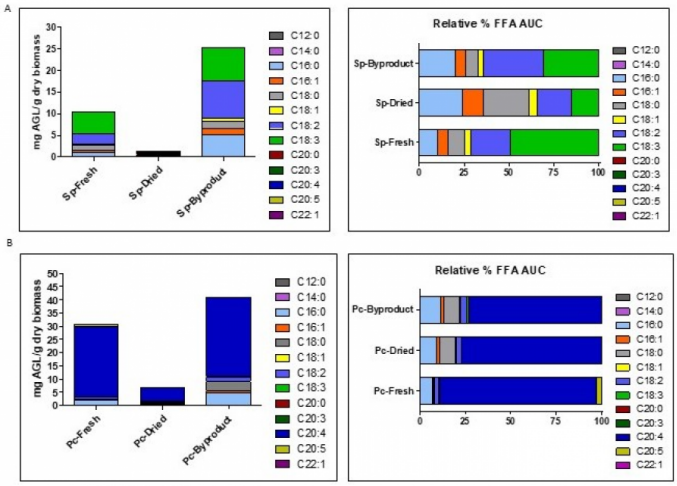


FIGURE 1

Impact of pre-treatment on biomass intergrity

SP = spirulina

PC = porphyridium cruentum

F= freezed

D = air dried

BP = by product of phycobiliprotein extraction

FIGURE 2

FFA content of biomasses after pre-treatment

Left : cumulative AUC afte LC-ESI-MS

Right : relative percentage of FFA fraction

KEYWORDS

biorefinery | deep eutectic solvent | pre-treatment

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