Pulsed Electric Fields and High Pressure Homogenization assisted extraction of valuable compounds from microalgae *C. vulgaris*

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Microalgae represents a rich source of valuable compounds (pigments, proteins, carbohydrates and lipids) with potential applications in cosmetic, nutraceutical, chemical and food sectors as well as for the production of biofuels. Most of the interesting compounds from microalgae are commonly stored either in the cytoplasm or in internal organelles, protected by the rigid cell wall and plasma membrane surrounding the cell, as well the chloroplast membranes, which greatly limit the rate of mass transfer of intracellular compounds during conventional extraction processes. Moreover, conventional extraction processes are generally conducted on dry biomass and often require long extraction time as well as the usage of relatively large amounts of organic solvents. For these reasons, over the last years, the use of innovative non-conventional technologies for processing of wet biomass in order to selectively or non–selectively increase the rate of mass transfer of high-added value compounds from the intracellular space, while reducing the energy costs, the solvent consumption and shortening the treatment time, has gained a growing interest. Among these technologies, pulsed electric field (PEF) and high pressure homogenization (HPH) are considered promising non–thermal cell disintegration techniques of biological cell, able to foster, respectively, the selective and non-selective release of intracellular compounds.

In this work the influence of the main processing parameters of the PEF treatment on the permeabilisation degree and on the extractability of carbohydrates and proteins from microalgae *Chlorella Vulgaris* was investigated, and compared with the more disruptive effects of HPH treatment.

Microalgae suspensions (1.2%, w/w) provided by the University of Genova, were subjected to PEF treatments at different electric field strengths (E=10–30 kV/cm) and total specific energy input (W_T=20–100 kJ/kg), while HPH treatments were carried out at constant pressure (P=150 MPa) and at different number of passes (n_P=1-10).

Determinations of time-conductivity profile of the biosuspension as well as quantification of dry matter, particle size distribution, and SEM analysis, revealed that PEF treatments were able to induce the permeabilization of cell membranes in a manner dependent on the treatment intensity, without any production of cell debris. HPH treatment, instead, induced total disruption of algae cells leading to the formation of large amount of cell debris. Consequently, as compared to the untreated samples, extracts of PEF treated biomass showed an increase in the amount of carbohydrates (36–78 %) and proteins (2–10 %) released into the supernatant from inside the algae cells, which were 1.3 and 7.5 fold lower than that detected for the HPH treated samples.

Results of this preliminary work demonstrated the different impact of PEF and HPH technologies on the efficiency of cell permeabilisation and extraction of valuable compounds from algae cells, which make them suitable for the integration in a multi-stage biorefinery, where PEF should represent the first disintegration step, while HPH should be placed at the end the cascade of operations.