Investigation of high throughput microfluidics on several microalgae cultures Evaluation of proteins recovery and comparison with ultrasonic treatment.

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Due to biological and metabolic richness of microalgae, their production is booming. A strong potential for large-scale application is expected in the industry. Numerous works are therefore dedicated to the improvement of processes that lead to the extraction of molecules of interest. A classical process generally encounters different steps, such as cells harvesting and concentration, extraction of molecules of interest and their purification. Several challenges have to be overcome due to the resistance of the cells to breakage and, on the other hand, due to the complex composition of the obtained cell mixture. Energy consuming mechanical devices, such as high-pressure homogenizers or bead milling, and/or unfriendly chemical substances are generally used for the cell rupture step. Energy and environmental constraints also explain the necessity of designing new devices and methodologies. This study investigates the effect of microsystems at high throughput on cells suspensions, as an intensified and intermediate way of altering cells structure. Microsystems at high throughput allow developing turbulent flows with high shear stress and elongation effects; they have already proven to be efficient in producing up to about 50 L/h of liquid/liquid or gas/liquid dispersions. In the present work, cultures of different species of microalgae have been submitted to one to several passes through a cross-slot microsystem. Its effect has been characterized determining the level of released proteins. Ultrasonic treatments of the cultures have been made in parallel for comparison. Complementary tests were also made adding isopropanol in order to couple a solvent extraction to the mechanical treatment. The results confirm a variability of cell wall resistance depending on the treated specie and on the physiological condition of the cells (nitrogen stress). Positive effects of the microsystems were observed with *Parachlorella kessleri* submitted to nitrogen stress. The recovery rate of proteins was shown to be enhanced with nitrogen stress, reaching 22%; comparatively, ultrasonic treatment allowed recovering 28% of proteins. In these conditions, the specific energy consumption per cell dry mass was eighteen times higher using ultrasonic system. The use of isopropanol, added after several passes of cells through the microsystem had a rather slight effect on protein recovery.