Editorial Corner

Prospect of Liquid Biphasic System in Microalgae Research

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Up to date, the downstream processing of biological products in industries is utilizing conventional approaches to produce and fulfil the market demands. As the population in worldwide growing significantly over decades, food demand is increasing in rapid rate especially for developing countries. In addition, the demand of dietary supplements is increasing as well due to more attentions given on health awareness with the improved living standards in most of the countries. To compromise with the large market demand, the industries have to discover efficient, simple and scalable processing technique in obtaining high recovery and purity of biological products while finding a solution to overcome the high food demand in worldwide.

Despite of efficient processing techniques, a viable natural source to supply bioactive compounds required for dietary supplements that does not compete with food resources is in desperate need to fulfil the market demand. Microalgae are the potential solution to current issue, as they consist of multiple valuable components such as lipid, carbohydrate, protein, vitamins, pigments and more. This special trait of microalgae has made them become more significant in the production of vast products across different industries. High value-added products like carotenoids, fatty acids, phycobiliproteins and vitamins can be utilized for biopharmaceuticals, nutraceuticals, human health and nutrition industries while lipid and carbohydrate can be processed for bioenergy production as microalgae also known as third generation biofuels feedstock. High composition of protein is discovered within microalgae biomass and potential to replace the conventional protein source as the microalgae possess high growth rate and able to survive under harsh condition. As compared to terrestrial plant, microalgae seem to be a better option to produce biomolecules for various applications as they do not require land for cultivation and can be cultivated using industrial wastewater and flue gas.

Due to the progressive revolution of biotechnology, biochemical products are in demands of various industrial sectors, especially in foods and pharmaceuticals. The critical step of the whole process for a viable and feasible production is the downstream processing involving in series of energy consuming steps for product recovery and purification. The estimated cost of the recovery and purification process can range from 10% up to 70% depending on the raw material and product characteristics. For the high-value protein products, due to its labile properties, it requires specific and mild processing to keep their natural properties and the costs for downstream processes are varied from 30–80% of the production cost.

Currently, many conventional extraction and purification techniques are available, such as adsorption, extractive distillation, chromatography and membrane separation. However, these techniques are practically limited due to their difficulties in scaling up, operation and maintenance, and shortage of proper biocompatible solvents. Therefore, there is a significant demand to

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develop the up-scalable, effective and economical downstream process for the recovery and purification of biomolecule products.

To obtain the valuable components within microalgae biomass, efficient and simple techniques such as liquid biphasic system (LBS) are developed for maximal recovery yield. These techniques have numerous advantages over conventional separation process, such as low time consumption, scalable, cost and energy saving, high separation efficiency and rapid mass transfer. Most of the studies performed using these techniques have not encountered denaturation of protein or degradation of targeted products due to the high water content of the system. Sonoprocessing is shown to be an effective and ideal option to break down cell wall of biomass in numerous studies. The sonication waves generate cavitational bubbles in the medium (consists of sample or biomass) and the collapse of these bubbles disrupts the cell wall due to the high shear gradients created. The inner components are then released with the rupture of cell wall. High mass transfer from samples to the medium, short processing time and less solvent usage have lead to great attention of researchers and industrial in extracting and purifying biomolecules. Hence, we have successfully to integrate sonoprocessing with the techniques mentioned in above paragraph to enhance the recovery of targeted compounds from microalgae biomass either in single step operation or as pre-treatment prior to extraction and purification. Single step operation is studied for extraction and purification of protein while two steps operation is investigated for high value-added products, phycocyanins. At last, a scaled-up system of Liquid Biphasic Flotation (LBF) assisted with sonoprocessing had been demonstrated as compared to a small-scale system of Liquid Biphasic System in extracting phycocyanins in our research work.

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