Abstract

On mapping the current global scenario, it is evident that the steadily increasing demand for environment friendly green/bio surfactants compounded by their relatively higher cost of production has necessitated the development of technologically feasible, economically viable and environmentally sustainable bio-manufacturing processes. The need of the hour is to bring about radical improvement in the overall performance of the process by rethinking the process as a whole. In this regard, process intensification strategies are strongly believed to shift the bioprocess paradigm towards reducing the gap between the upstream and downstream process performances, particularly in terms of efficient recovery and purification of the product of interest. In this thesis, process intensification strategies were applied at different bioprocessing stages for the augmented production and purification of lipopeptide from a marine strain of *Bacillus megaterium*. Firstly, a suitable Fe^{2+} feeding strategy was devised for the enhanced lipopeptide production in shaker flasks. This was followed by the optimization of processing and cultivation conditions, from which, it was established that the lipopeptide selectivity was strongly influenced by the limitations in oxygen and nitrate in the medium imposed by the processing conditions. In the subsequent studies for continuous lipopeptide production by foam fractionation, the optimal conditions that resulted in concomitant production and separation of lipopeptide were successfully established, by adopting a three stage cell cultivation strategy. The resulting crude lipopeptide product was then partially purified by cross flow ultrafiltration (CFUF). The CFUF of size conditioned lipopeptides by Ca^{2+} ions operated under dia-filtration mode not only enhanced the recovery of surfactin and fengycin families but also effectively removed the high molecular weight impurities from the crude lipopeptide. Finally, an isocratic elution method was developed and validated in RP-HPLC using C-18 column for the purification of lipopeptide into its constituent families. The optimal conditions of analytical HPLC were then successfully scaled up to Prep-HPLC. The partially pure lipopeptide was evaluated for its capping and stabilizing capabilities in silver nanoparticle synthesis. Thus, the application of process intensification strategies by capitalizing on important product characteristics significantly improved the overall process performance for lipopeptide production and purification.

Keywords: Marine microbial lipopeptide; Process intensification; Fe^{2+} supplementation; Foam fractionation; Product purification; Cross Flow Ultra-Filtration; Micelles size conditioning; Dia-filtration; Analytical HPLC; Prep-HPLC; Application; Silver Nanoparticle synthesis; Lipopeptide as Capping agent; Lipopeptide as Stabilizing agent