Integrated approach coupling microbiological process and *in situ* product recovery for the production of 3-hydroxypropionic acid by *Lactobacillus reuteri*

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Abstract

In the actual environmental and economic context, there is an increased interest in the microbial production at a large industrial scale of 3-hydroxypropionic acid (3-HP). Among its various applications, this compound is primarily sought for its direct use as building block mainly for the synthesis of bio-based polymers and the production of commercially valuable chemicals. Although 3-HP is currently of limited usage due to its exclusive synthesis via chemical pathways [1], its market is expected to significantly grow up to a volume of 20,000 tons per year in 2015 with a cost of 1,100 $ per ton [2]. Moreover, in recent years, the tremendous growth of biodiesel manufacturing industries resulted in a large production of inexpensive and abundant available glycerol as by-product that could be used as substrate. Until now, only lactic acid bacteria from the *Lactobacillus* genus have been shown to produce 3-HP from glycerol, although at low productivity [3].
In the present work, the bioconversion of glycerol into 3-HP by *Lactobacillus reuteri* was studied. Product and its metabolic intermediate 3-hydroxypropionaldehyde (3-HPA) were identified to exhibit inhibitory effects on the producing microorganism, thus leading to a low productivity. A potential strategy to increase the performance of the microbial cells and to recover the molecule of interest is the "*In Situ* Product Recovery" (ISPR), by which upstream bioconversion is combined to downstream recovery. ISPR of 3-HP was implemented using reactive extraction with tertiary and quaternary amines diluted in n-decanol. Extraction in a hollow fiber-membrane contactor from a model binary solution of 3-HP in water was successfully performed. The effect of glycerol, 3-HPA and 1.3 propanediol, as being the molecules of the 3-HP pathway, was studied in terms of extraction kinetic, yield and selectivity. Results demonstrated the high potential of this integrated approach coupling microbiological process and membrane-supported reactive extraction for the biotechnological production of 3-HP.

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