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BIOBASED 3-HYDROXYPROPIONIC ACID PRODUCTION AND EXTRACTION STARTING FROM GLYCEROL: TOWARDS A SUSTAINABLE INTEGRATED PROCESS

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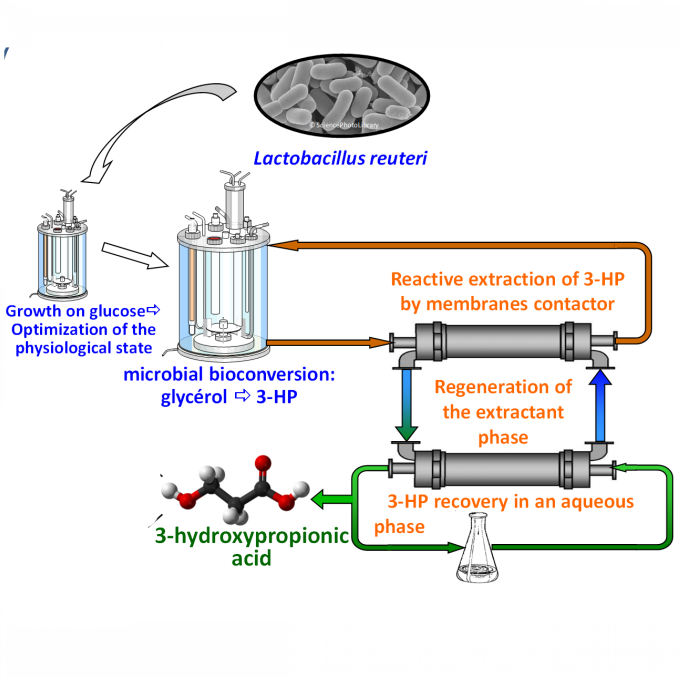
ABSTRACT

In the actual environmental and economic context, there is an increased interest in the microbial production at a large industrial scale of the bifunctional weak carboxylic acid, the 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. Moreover, 3-HP has enormous potential for 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 according to a report of the International Energy Agency IEA-Bioenergy (2012) 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) are suspected to exhibit inhibitory or toxic effects on the producing microorganisms, thus leading to low productivity and dilute product stream. This entails high costs for isolation and purification of the product. A potential strategy to relieve the inhibitory stress, to increase the performance of the microbial cells and to recover the molecule of interest is to implement an ?In Situ Product Recovery? (ISPR), by which upstream bioconversion is combined to downstream extraction and recovery.

A promising technique that drew a lot of attention lately for the extraction of hydroxypropionic acids is the reactive extraction in an organic phase containing an extractant [4]. In the present work, the in situ 3-HP recovery was studied using the long chain tertiary amine trioctylamine (TOA) and the quaternary ammonium salt tri-n-octylmethylammonium chloride (Aliquat 336) as extractants, and n-decanol as diluent.

Optimisation of the 3-HP reactive extraction assisted by hollow fiber-membrane contactor was displayed. In addition, the 3-HP in situ product recovery was studied and its performances were characterized. These results thus demonstrate the high potential of this ISPR technique applied for the biotechnological production of 3-HP.



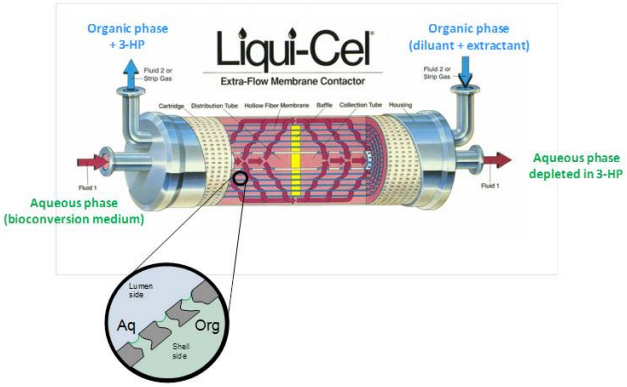


FIG1 LEGEND

Diagram of the 3-HP production and extraction integrated process

FIG2 LEGEND

Principle of hollow-fiber membrane contactor

KEYWORDS

In Situ Product Recovery | 3-hydroxypropionic acid (3-HP) | reactive extraction | hollow fiber membrane contactor | glycerol bioconversion

REFERENCES

[1] Ferreira BS. Ten-Year Forecast of Disruptive Technologies in Industrial Biotechnology to 2021, 2011

[2] Paster M et al. DOE Industrial Bioproducts: Today and Tomorrow: 48-49, 2003

[3] Talarico TL et al. Production and isolation of reuterin, a growth inhibitor produced by Lactobacillus reuteri. Antimicrob Agents Chemother 32:1854?1858, 1988

[4] Kyuchoukov G and Yankov D., Lactic acid extraction by means of long chain tertiary amines: a comparative theoretical and experimental study. Industrial & Engineering Chemistry Research 51(26): 9117-9122, 2012

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