

Abstract Submission

Submission-1058

Topic : / ECCE10 / Fluid separations processes and technologies / integrated, hybrid and novel separations

REACTIVE LIQUID-LIQUID EXTRACTION AND BACK-EXTRACTION OF BIO-BASED 3-HYDROXYPROPIONIC ACID: TOWARDS THE IMPLEMENTATION OF AN INTEGRATED PROCESS OF EXTRACTIVE BIOCONVERSION

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Submit your abstract below (400 words): The 3-hydroxypropionic acid (3-HP) is a platform molecule that can be obtained via the bioconversion of different bioresources like glycerol and sugars. It offers a wide range of applications within various fields such as bio-based acrylic acid production and bio-based polymer materials. The American Department of Energy (DOE) ranked this molecule among the 12 "Top value-added chemicals from biomass"¹. Bioconversion is considered as a favorable process but highlights a lack of efficiency due to the inhibitory effect of the acid and its metabolic intermediate, 3-hydroxypropionaldehyde, on the micro-organism².

The integration of an *in-situ* extraction process of 3-HP to the bioconversion system could lead to an inhibition decrease and to the continuous extraction of the desired product. The setting-up of this extraction step is of prime importance for the optimization of an integrated process. The considered technique in this study is the reactive liquid-liquid extraction mediated by a membrane contactor. It allows the cells to prevent the direct contact with the organic phase and shows a high specific surface area unrivaled when compared to usual dispersive processes without creating emulsion³. All these features are consistent with a process intensification goal. The reactivity due to the presence of amines in the diluent controls the selectivity of the process and this reactivity has a specific behavior according to the concentrations, the type of diluent, the acid extracted and the temperature⁴. Moreover, a back-extraction step can be coupled to the extraction step with a second contactor to favor the mass transfer and get the product back in an aqueous phase.

The aim of this work consisted in studying the reactive extraction of 3-HP and its recovery into aqueous phases. On one hand, different organic diluents have been used for the extraction step in order to determine their efficiency and biocompatibility: decanol, vegetable oil and oleyl alcohol. On the other hand, 2 extractants have been studied alone or in mixtures: trioctylamine (tertiary fatty amine) and Aliquat 336 (quaternary fatty ammonium salt). The aqueous phases containing 3-HP consisted in different model solutions or bioconversion media. The back-extraction aqueous phase was tested with different reagents such as basic or neutral salts. The effect of temperature has also been considered. Mass transfer coefficients in the membrane contactor are presented for several tested conditions. The results show a great importance of the solvent selection, the nature of the initial aqueous phase and the reagents used in organic or aqueous phases on the overall extraction yields and kinetics.

Type of presentation :: No preference

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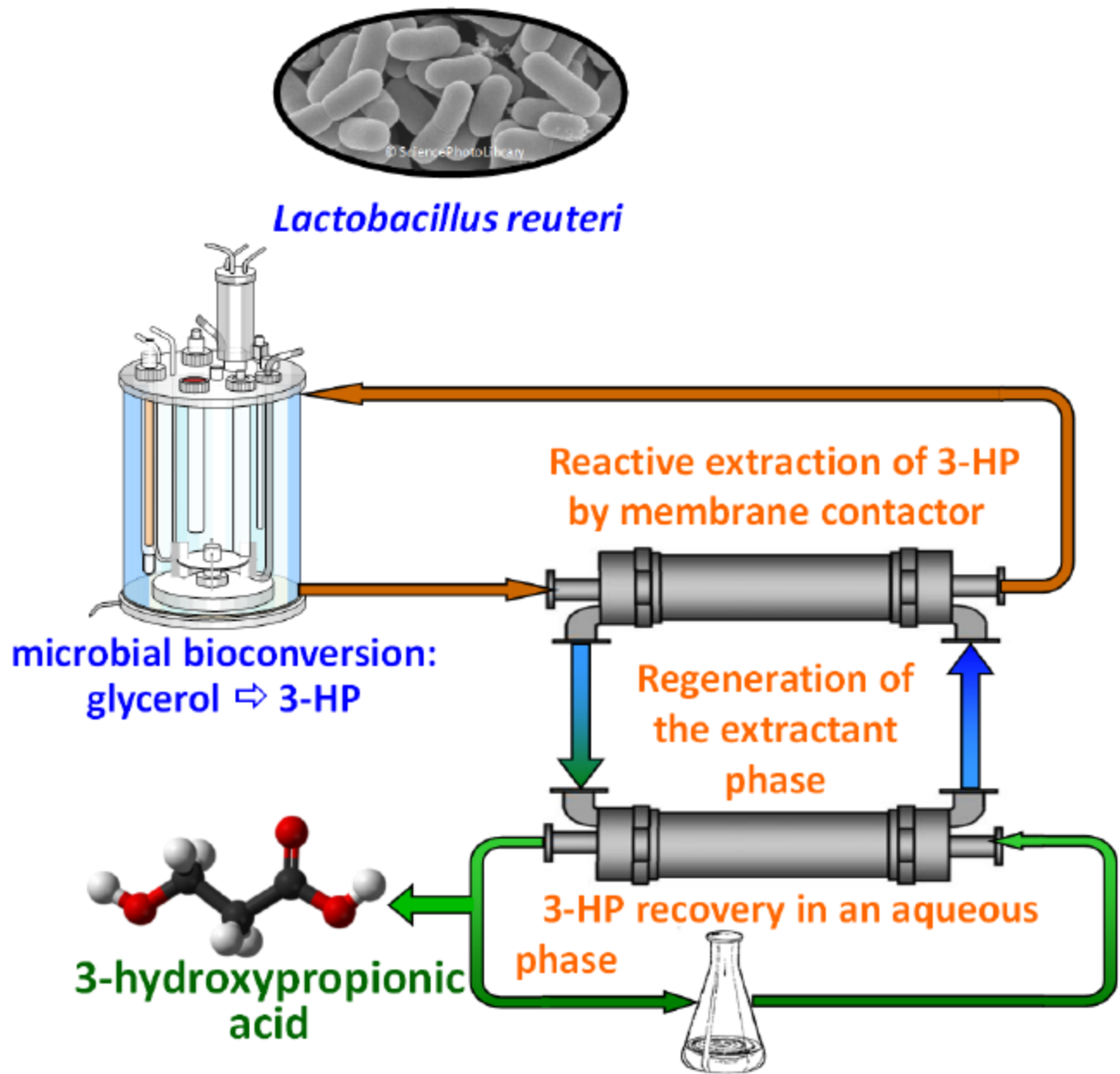


Figure 1: Integrated process for extractive bioconversion of 3-hydroxypropionic acid

Highlight 1: 3-hydroxypropionic acid as a bio-based platform molecule (from renewable resources)

Highlight 2: Membrane contactors for (bio)process intensification

Highlight 3: Towards the implementation of selective recovery through extractive bioconversion

Reference 1 :: Werpy t, peterson g, top value-added chemicals from biomass, 2004, pp. 29-31

Reference 2 :: Dishisha T, Pereyra L, Pyo S, Britton R, Hatti-Kaul R, Flux analysis of the *Lactobacillus reuteri* propanediol-utilization pathway for production of 3-hydroxypropionaldehyde, 3-hydroxypropionic acid and 1,3 propanediol from glycerol, *Microbial Cell Factories*, 2014, 13:76

Reference 3 :: Pierre F-X, Souchon I, Athes V, Marin M, Membrane-based solvent extraction of sulfur aroma compounds: influence of operating conditions on mass transfer coefficients in a hollow fiber contactor, *Desalination*, 2002, 148, pp. 199-204

Reference 4 :: Tamada J A, King C J, Extraction of carboxylic acids with amine extractants. 3. Effect of Temperature, Water Coextraction, and Process Considerations, *Industrial and Engineering Chemistry Research*, 1990, 29, pp. 1333-1338

Keywords: Biomolecules, Extraction, Intensification, Membrane, Renewable resources