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OF
ABSTRACTS

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solutions treatments opportunities

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SIMULTANEOUS SACCHARIFICATION AND FERMENTATION: A TOOL TO IMPROVE FOSSIL FUELS BIODESULFURIZATION USING GORDONIA ALKANIVORANS STRAIN 1B

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ABSTRACT

Introduction

The combustion of oil and its derivatives releases into the atmosphere sulfur compounds, such as SO2. These contribute towards problems such as the acid rains and the hole in the ozone layer as well as cancer and cardiac diseases. This led several countries to develop legislation that greatly restricts sulfur levels on oil derivatives. In response refineries were forced to implement hydrodesulfurization, combining high temperatures and pressures, with metal catalysts. However, hydrodesulfurization cannot efficiently remove the sulfur from recalcitrant molecules such as dibenzothiophene (DBT), making the process very expensive and leading to a loss of calorific value of the fuels. This technic also leads to the production of some hard to treat wastes resulting from the over used metal catalysts which are usually aluminum based representing a health hazard.

A complementary technology is biodesulfurization (BDS) in which microorganisms remove the sulfur at low temperatures and pressures, without the need for metal catalysts. This leads to a reduction of energetic costs and wastes produced, and residual loss of calorific value.

However in order to this technology become economically viable it is fundamental to lower its operating costs, namely by using cheaper carbon sources to grow the desulfurizing microorganisms. The use of agro-industrial materials as alternative carbon sources could be a good choice because of their low cost, but usually these feedstocks contain large amounts of sulfates which is a drawback for the desulfurization process and so a pretreatment with BaCl2 is necessary to remove sulfates prior to BDS assays [1,2].

In this context, and knowing that Gordonia alkanivorans strain 1B is a fructophilic bacterium, two agro-industrial materials progressively richer in fructose, namely beet molasses and Jerusalem artichoke juice were selected, treated with BaCl2 and tested for DBT-desulfurization by strain 1B using a simultaneous saccharification and fermentation (SSF) approach with the application of invertases/inulinases.

Material and methods

For the SSF assays was used a crude enzymatic extract with invertase and inulinase activities, which was obtained from the supernatant of a culture of Zygossacharomyces bailii Talf1 [3]. This extract, dialyzed and filter sterilized, was added to a sulfur free minimum salt medium [1] supplemented with molasses or JAJ as the carbon source, after treated with BaCl2, and 400 microM DBT. Control assays were carried out without enzyme extract addition. The cultures of strain 1B were incubated at 30°C, pH 7.5 and 150rpm. Results were evaluated by GC for DBT and 2-hydroxybiphenyl (2-HBP), HPLC for sugars quantification and absorbance and dry weight for cellular growth.

Results

In this study, the results for molasses showed a maximum growth rate of 0.0796 h-1 in SSF with enzymatic extract, which is 115 % higher than for sucrose and 14% higher than for sucrose in SSF, in accordance to lower

affinity from G. alkanivorans to sucrose in relation to fructose. In terms of desulfurization, namely of maximum 2-HBP specific production rate (q2-HBP), the molasses SSF attained 4.093 micromol/g(DCW)/h in contrast with 1.11 micromol/g(DCW)/h for sucrose and 2.61 micromol/g(DCW)/h for sucrose SSF.

For the JAJ, the addition of inulinases in a SSF process as an alternative approach to the acidic hydrolysis treatment allowed also the achievement of remarkable results, surpassing those previously obtained both with the acid hydrolyzed JAJ and commercial fructose [2]. Within JAJ SSF, G. alkanivorans attained a maximum growth rate of 0.1288h-1 which represents a desulfurization increase of 84% and 114%, respectively, relatively to BDS assays with fructose and acid hydrolyzed JAJ. In terms q2-HBP, the JAJ SSF accomplished 8.33 micromol/g(DCW)/h, which is 27% higher than for commercial fructose and 65% higher than for acid hydrolyzed JAJ.

These results highlight the great potential of the application of invertases/inulinases within a SSF approach to the BDS process using agro-industrial carbon sources.

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