Implications of the Heat Shock Treatment During the Bioconversion of Crystalline Cellulose into Hydrogen by a Microbial Consortium

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ABSTRACT

The fermentative hydrogen production using microbial communities (MC) as inoculum has advantages such as high production rates, the use of organic waste as substrate, and the reactor operation under unsterile conditions which decrease the operation costs. These MC are obtained from sources such as anaerobic digester sludge, sewage treatment plants, wastewater, ruminal fluids, and composts, among others. In most studies using these inocula, the heat-shock treatment (hst) is applied to enrich with *Clostridium* species and kill the rest of microorganisms. This hst is highly effective when the substrate consist of easily fermentable sugars. On the other hand, agricultural residues also called lignocellulosic substrates, have a high potential for its conversion into biohydrogen. Its composition shows up to 70% polysaccharides (cellulose and hemicellulose), and its bioconversion has been mainly reported with the use of physical-chemical pretreatments, and/or enzyme which negatively affect the operation costs. The aim of this work was to study the conversion of crystalline cellulose into hydrogen by MC derived from anaerobic digester sludge. Inocula tested were complete MC, and a heat-shocked MC (boiling in a water bath for 60 min). such as a control, a culture of *Clostridium acetobutilicum* was used. The assays were performed in mini-reactor with a working volume of 100 ml with 6 g / L of crystalline cellulose (SIGMA) in PYG medium and initial pH of 5.5. Mini-reactors were statically incubated at 37 °C. The parameters measured were volume and composition of biogas, cellulose consumption and cell growth. The results showed that biogas production from cellulose was higher using the complete MC (151 mL), while the heat-shocked MC produced 42 mL and *C. acetobutilicum* 19 mL. These results show that the sht negatively affects the cellulose conversion into hydrogen due to the reduction of microorganisms needed for the efficient hydrolysis and fermentation of the cellulosic substrate.

Keywords: cellulose, hydrogen, fermentation.