FERMENTATIVE HYDROGEN PRODUCTION BY MICROBIAL CONSORTIA USING RESIDUAL GLYCEROL FROM BIODIESEL PRODUCTION

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Abstract:

Hydrogen production via anaerobic fermentation from residual glycerol is an attractive alternative for clean energy. Biological hydrogen production is considered the most environmentally friendly way of producing energy. The combustion of this fuel produces water as its only product and generates 122kJ.g^{-1}, which is almost 3-fold higher than fossil fuels. Furthermore, the residual glycerin from biodiesel is an excellent option for hydrogen production via anaerobic fermentation due to the following advantages: renewable energy production, process cost reduction and waste accumulation avoidance . In this study, the feasibility of standard glycerol and crude glycerol as substrates for hydrogen production were evaluated using microbial consortia from anaerobic sludge (volatile suspended solids: 17,33g.l^{-1}). Firstly, anaerobic sludge was pretreated (pH 2,0; 1h) in order to inhibit methanogenic archaea and enrich H_2-producing bacteria. Then, four cultivation media were tested: GStN (standard glycerol with addition of nutrients medium); GSt0 (standard glycerol without addition of nutrients medium); GCrN (crude glycerol with addition of nutrients medium) and GCr0 (crude glycerol without addition of nutrients medium). The relationship among volatile suspended solids (VSS) of inocula and chemical oxygen demand (COD) of glycerol was 1:1 (w:w) and the pH was adjusted to 7,0. Before incubation at 35°C and 150 rpm, the flasks were purged with N_2 in order to ensure an anaerobic environment. Experiments conducted using standard glycerol showed lower H_2 production than experiments that used crude glycerol as substrate. This result could be due to the presence of some nutrients, such as fatty acids and potassium and sodium salts, in this residue. The presence of these nutrients also explains the fact that GCrN and GCr0 media showed comparable H_2 production. The highest yield of H_2 (1,21 ± 0,05 mol H_2 / mol glycerol) was obtained after 20 h of incubation on GCr0 medium, H_2 production using GCr0 medium was 30% higher than using GStN medium and 81% higher than using GSt0 medium. This result confirms that is possible to produce hydrogen using crude glycerol, without previous purification, as substrate through a clean, low cost and environmentally friendly process. The application of crude glycerol without enrichment for fermentation represents a huge advanced on feasibility of H_2 production by reducing costs.