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ISOLATION OF NEW PHOTOFERMENTATIVE BACTERIAL STRAINS FOR BIOHYDROGEN PRODUCTION

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Abstract

Energy demand is expected to grow as the world population increases. Hydrogen is an ideal energy source from an environmental and economical point of view since it has a high energy yield (122 kJ/g), 2.75 times higher than that of hydrocarbons, and is a clean energy carrier since it only produces water upon combustion. Dark fermentation and photo-fermentation are the two main microbial hydrogen production processes. With dark fermentation, maximum energy conversion of organic substrates to hydrogen is 40%, and organic acids, such as acetate and butyrate, and alcohols are produced as byproducts. Photo-fermentation can convert organic acids and alcohols into hydrogen using light as an energy source. Photofermentative bacteria are promising since they can carry out complete substrate conversion.

In order to isolate new photofermentative bacterial strains mud samples were taken from the St. Lawrence River (Valois Bay). The mud and enrichment medium were circulated through packed bed reactors exposed to light to select biofilm forming bacterial strains. Four reactors packed with four different materials: resins, molecular sieve, charcoal, and controlled pore glass beads, to provide a surface for biofilm formation were kept at 30°C in an environmental chamber providing a light intensity of 200 W/m^2. The enrichment solution was circulated through the packed reactors with a peristaltic pump until red pigmented bacterial growth was observed, which took ~ three weeks. As a control group a 100 mL batch reactor without support material was run in parallel in the chamber. Material from each of the four different reactors was then taken for strain isolation. Four morphologically different colony types were observed after isolation. The colonies transferred into the liquid media in order to determine vitamin and substrate requirements.

DNA isolation was done by Qiagen DNeasy Tissue & Blood PCR for molecular analysis using a Bigdye V.3.1 Cycle Sequencing kit (using 27F AGAGTTTGATCMTGGCTCAG and 1492R GGTTACCTTGTTACGACTT primers) and an ABI 3130 XL Genetic Analyzer. Phylogenetic analyses were done using the neighbor joining method. According to the phylogenetic analysis shown in the figure below possibly 3 new strains along with a *Rhodobacter capsulatus* strain were observed.

The new isolates were tested for growth on different concentrations of lactate, butyrate and acetate, the main end products of the dark fermentative hydrogen production process. The optimal lactate and acetate concentrations were 5 g/L and butyrate concentration was 3 g/L. Cumulative hydrogen production capacities were relatively low, but H_2 was between 60-80% and the rest was CO_2. The biohydrogen production capacities of the isolates could be improved by further characterization and optimization studies especially in regards to substrate and vitamin requirements.

***Optimization studies are ongoing.