Poster 1.1.27

Evaluation of *Fusarium oxysporum* consolidated system for ethanol production from the liquefied hydrothermally pretreated wheat straw fiber fraction

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Wheat straw is a low cost agricultural residue that can be used to produce ethanol. The goal of this study is to evaluate the *Fusarium oxysporum* consolidated system both as an enzyme source in combination with industrial cellulolytic enzymes and as a fermentative organism for the conversion of hydrothermally pretreated wheat straw (PWS) into ethanol at high dry matter content.

PWS is pre-hydrolysed with the addition of 5 FPU g^{-1} DM of commercially available enzymes Celluclast® 1.5L and Novozym® 188 at 50°C for 8 hours and then used as a substrate for fermentation in SSF process using Dry Bakers Yeast alone or in mixed culture with *F. oxysporum*. About 25% and 35% increase in ethanol production obtained with a *F. oxysporum* enzyme loading of 2 and 5 FPU g^{-1} DM, respectively, added at start up of SSF. The final ethanol concentration was 50 g L^{-1} (v/w).

Finally, in order to examine the combined effect of both enzymes and cells on ethanol production by *Fusarium oxysporum* on pretreated wheat straw, response surface methodology (RSM) was used. It was found that both *F. oxysporum* cells and enzymes have a positive effect on fermentation. Their addition can lead to 82% of the theoretical production based on the cellulose content of material. Those two factors it is shown that have a linear effect on the productivity. The enzymic system increases the saccharification and the presence of *F. oxysporum* increases the ethanol production by converting the xylose to ethanol aiding *S. cerevisiae*.

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Poster 1.1.28

Photofermentative biohydrogen production from sugar beet molasses

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The world's energy demand is continuously increasing. Therefore alternative energy sources are needed. Hydrogen is one of the alternative energy sources and can be produced via photofermentation by photosynthetic bacteria like *Rhodobacter sphaeroides* using renewable and sustainable biomass sources. In this study, sugar beet molasses has been used as carbon source.

First sugar, element and ammonium analyses of molasses have been done. Total sugar has been found to be 44%. Element analysis by ICP-MS demonstrated that there are molybdenum (0.012 mg/L) and iron (0.468 mg/L). These are two metal ions that are required for the nitrogenase activity. The ammonium amount was found to be 2.5 ppm which is below nitrogenase suppressive concentrations. Upon these analyses, it seemed that molasses could potentially be used as substrate for photosynthetic bacteria.

After pretreatments, 10% inoculations have been done in 4 g/L, 5 g/L, 6 g/L, 7 g/L and 8 g/L sugar containing media in 50 mL bioreactors. *R. sphaeroides* cells have been incubated at 30°C under light. The pH of the culture first increased up to 8.5 and then decreased back to 7. The highest cell masses obtained in 8 g/L sugar containing media (OD_{660} = 6.6). Interestingly as the sugar concentration increased from 4 to 8 g/L, total hydrogen production decreased from 0.34 to 0.30 L H_2/L culture. This might have been resulted from dark color of the media which decreased the light penetration. As a conclusion, molasses could be used as substrate for growth and hydrogen production by *R. sphaeroides* after dilutions with water.

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Poster 1.1.29

Photofermentative biohydrogen production from barley waste

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Hydrogen, as being the candidate for the future alternative energy carrier, can be produced through photofermentation by photosynthetic bacteria using renewable and sustainable biomass sources. In this study, barley waste obtained from a malt producing factory has been used as substrate for biohydrogen production. Barley waste has been hydrolyzed at 121°C for 30 minutes at pH 3 to obtain fermentable sugars for *Rhodobacter sphaeroides* O.U.001. The element analysis of hydrolysate by ICP-MS showed that iron and molybdenum which are required for hydrogen production should be added externally. Ammonium inhibits nitrogenase enzyme and therefore hydrogen production is ceased. For this reason, ammonium amount has also been determined by ammonium test kit (Norateks, Turkey) and it was found to be 2.5 ppm which is below inhibiting concentrations. Finally, total sugar was found to be 48.14 g/L by acid-phenol spectrophotometric method. After pH adjustment (pH = 7), element and vitamin additions, composition of hydrolysate was made suitable for growth and hydrogen production.

Several concentrations of sugars (5 g/L, 6 g/L, 7 g/L, 8 g/L, 9 g/L, 11 g/L) have been prepared as media and they were inoculated by *R. sphaeroides* (10%). The pH of the culture was around 7 during the process and the highest cell mass was obtained when the sugar concentration was 11 g/L. As a trend, increasing the sugar concentration led to the higher cell biomass. Similarly the highest hydrogen was obtained in the 11 g/L sugar containing bioreactor (0.51 L H_2/L culture). The gas chromatography analyses of the gases showed that 95–98% of the gases were hydrogen. These findings for the first time demonstrated that barley waste hydrolysates could potentially be used as sustainable substrate for growth and photofermentative hydrogen production by *R. sphaeroides*.

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