Extreme thermophilic ethanol production from rapeseed straw: using the newly isolated Thermoanaerobacter pentosaceus and combining it with Saccharomyces cerevisiae in a two-step process

The newly isolated extreme thermophile Thermoanaerobacter pentosaceus was used for ethanol production from alkaline-peroxide pretreated rapeseed straw (PRS). Both the liquid and solid fractions of PRS were used. T. pentosaceus was able to metabolize the typical process inhibitors present in lignocellulosic hydrolysate, namely 5-hydroxymethyl furfural (HMF) and furfural, up to concentrations of 1 and 0.5 g l⁻¹, respectively. Above these levels, xylose consumption was inhibited up to 70% (at 3.4 g-furfural l⁻¹) and 75% (at 3.4 g-HMF l⁻¹). T. pentosaceus was able to grow and produce ethanol directly from the liquid fraction of pretreated rapeseed straw, without any dilution or need for additives. However, when the hydrolysate was used undiluted the ethanol yield was only 37% compared to yield of the control, in which pure sugars in synthetic medium were used. The decrease of ethanol yield was attributed to the high amounts of salts resulting from the alkaline-peroxide pretreatment. Finally, a two-stage ethanol production process from PRS using Saccharomyces cerevisiae (utilization of hexoses in the first step) and T. pentosaceus (utilization of pentoses in the second step) was developed. Results showed that the two strains together could achieve up to 85% of the theoretical ethanol yield based on the sugar composition of the rapeseed straw, which was 14% and 50% higher compared to the yield with the yeast or the bacteria alone, respectively. Biotechnol. Bioeng. © 2012 Wiley Periodicals, Inc.
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