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Real-time monitoring of continuous fermentation by Raman spectroscopy

Title (Swedish)

Abstract

The production of bio-ethanol from lignocellulosic material requires a more efficient process to be feasible and compete with products from fossil fuels. There is a need to rapidly and non-destructively be able to determine key components during fermentation. Raman spectroscopy is a technique, which can be used to monitor the fermentation process in real-time and provide information about key components which can be accessed immediately, thus facilitating process control. A continuous system with membrane cell recycling was set up and fermentations were performed using *Saccharomyces cerevisiae* ATCC 96581. Fermentations were performed to test for optimal dilution rates and operating times, the effect of different sugar concentrations in the media feed, and which position in the system was optimal for Raman data collection. Raman data and aliquot samples for HPLC validation were continuously collected throughout the fermentations. Raman data was analysed with PLS models to obtain component concentrations, for which RMSE was calculated in order to compare to HPLC validation set. Fermentations were performed with synthetic glucose media as well as with poplar hydrolysate. It was shown that the continuous system with membrane cell recycling could achieve a glucose-to-ethanol conversion of between 75-100%. The process could be sufficiently monitored by Raman spectroscopy, and predicted concentrations were within the range of the validation set in most cases. However, the error of prediction varied between the different fermentations.

Keywords

Raman spectroscopy, continuous fermentation, real-time monitoring

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