Online monitoring of fermentation processes via non-invasive low-field NMR.

Kreyenschulte D, Paciok E, Regestein L, Blümich B, Büchs J (2015) Online monitoring of fermentation processes via non-invasive low-field NMR. *Biotechnol Bioeng* 112(9), 1810-1821.

Abstract

For the development of biotechnological processes in academia as well as in industry new techniques are required which enable online monitoring for process characterization and control. Nuclear magnetic resonance (NMR) spectroscopy is a promising analytical tool, which has already found broad applications in offline process analysis. The use of online monitoring, however, is oftentimes constrained by high complexity of custom-made NMR bioreactors and considerable costs for high-field NMR instruments (>US$200,000). Therefore, low-field (1) H NMR was investigated in this study in a bypass system for real-time observation of fermentation processes. The new technique was validated with two microbial systems. For the yeast Hansenula polymorpha glycerol consumption could accurately be assessed in spite of the presence of high amounts of complex constituents in the medium. During cultivation of the fungal strain Ustilago maydis, which is accompanied by the formation of several by-products, the concentrations of glucose, itaconic acid, and the relative amount of glycolipids could be quantified. While low-field spectra are characterized by reduced spectral resolution compared to high-field NMR, the compact design combined with the high temporal resolution (15 s-8 min) of spectra acquisition

allowed online monitoring of the respective processes. Both applications clearly demonstrate that the investigated technique is well suited for reaction monitoring in opaque media while at the same time it is highly robust and chemically specific. It can thus be concluded that low-field NMR spectroscopy has a great potential for non-invasive online monitoring of biotechnological processes at the research and practical industrial scales.

Leibniz-HKI-Authors

Lars Regestein

Details

Identifier

doi: 10.1002/bit.25599

PMID: 25850822