Abstract

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Applicability of near-infrared spectroscopy for process monitoring in bioethanol production

The applicability of near-infrared (NIR) spectroscopy to bioethanol production is investigated. The NIR technique can provide assistance for rapid process monitoring, because organic compounds absorb radiation in the wavelength range 1100–2300 nm.

For quantification of a sample's chemical composition, a calibration model is required that relates the measured spectral NIR absorbances to concentrations.

For calibration, the concentrations in g/l are determined by the analytical reference method high performance liquid chromatography (HPLC). The calibration models are built and validated for moisture, protein, and starch in the feedstock material, and for glucose, ethanol, glycerol, lactic acid, acetic acid, maltose, fructose, and arabinose in the processed broths. These broths are prepared in laboratory experiments: The ground cereal samples are fermented to alcoholic broths ('mash'), which are divided into an ethanol fraction and the residual fraction 'stillage' by distillation.

The NIR technology together with chemometrics proved itself beneficial for fast monitoring of the current state of the bioethanol process, primarily for higher concentrated substances (>1 g/l).