Rapid determination of recalcitrant organic carbon applying Near Infrared Spectroscopy (NIRS) and a Fourier Transform Infrared-Photoacoustic Spectroscopy (FTIR-PAS) for biogas production

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1. Background and Aim

Lignin is an important recalcitrant carbon pool, since it is known to be non-degradable during anaerobic digestion. Wet characterization of lignin analysis is expensive and labor intensive.

Lignin controls enzymatic hydrolysis of cellulose which results in low biodegradability, and further low biogas yield of lignocellulosic biomass.

The inverse correlation between lignin and biogas production potential has been reported in a number of recent studies, which highlight the importance of lignin analysis with regard to biogas production of lignocellulosic biomass.

2. Methodology

We compare the precision of the lignin concentration assessed by near infrared spectroscopy (NIRS) and a Fourier Transform Infrared-Photoacoustic Spectroscopy (FTIR-PAS).

FTIR-PAS

Nicolet 6700, PA detector: PA-301 (Gasera ltd, Finland), Resolution: 4 cm⁻¹, Number of scans: 32, Mir region: 4000-600 cm⁻¹.

3. PLS Modelling Results

We tested the Partial Least Squares (PLS) model by applying a series of pre-processing methods using either PLS Toolbox with Matlab or Unscrambler for data analysis. A total of 54 plant biomass samples were used for model calibration and cross validation was performed for model prediction.

4. Conclusion

The precision of the best PLS model using FTIR was satisfactory. It is found that FTIR-PAS had better prediction of lignin and the model was moderately successful using it. The study highlights that FTIR-PAS can be applied as an alternative method to assess recalcitrant carbon for biogas production.

5. Reference