Lignin in Plant Biomasses: Accuracy of the Detergent Fiber and the Dietary Fiber methods, and Correlation Between these Methods

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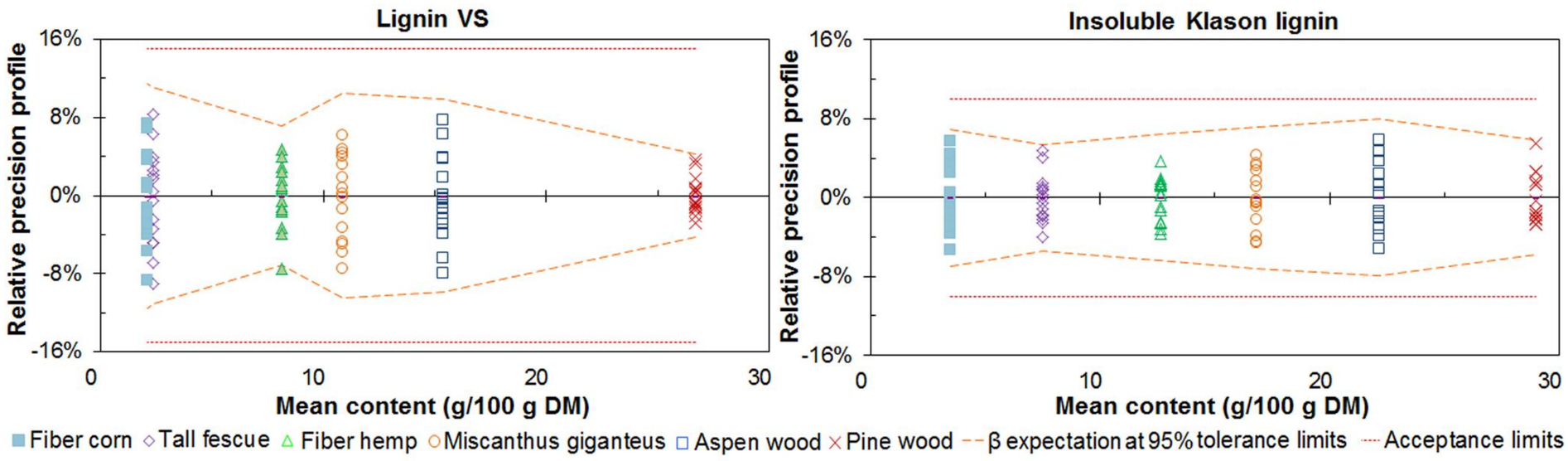
Introduction

- **Lignin is the most important source of natural phenolic compounds**. It is a complex three-dimensional phenylpropane polymer found in the cell walls of vascular plants. The core lignin is formed of three types of phenylpropane units: sinapyl, coniferyl and p-coumaryl alcohols.
- **Lignin needs to be quantified accurately** to estimate well its available amounts and to have a better understanding of its impact on the enzymatic hydrolysis of the cell wall carbohydrates in the rumen and in the cellulosic ethanol process.

Lignin quantification

- **The detergent fiber (Van Soest ; VS) and dietary fiber (sulfuric acid hydrolysis ; SAH) methods were compared to quantify lignin** of plant biomasses based on their accuracy (precision and bias) and on the correlation between these methods.
- **To avoid an excessive overestimation of the lignin quantification of the dietary fiber method by proteins**, the **Van Soest neutral detergent was used** as first extraction step in the present study. This enables **a better standardized first residue** with cellulose, hemicelluloses and lignin for the further analyses.
- **The bias was assessed on the basis of the mass balance of the neutral detergent fiber residue (NDF).** This balance also enabled to evaluate if the lignin content is not excessively overestimated when the mass balance is above 100%.

Precision assessment



- **Dietary fiber method has a higher precision for the quantitation of lignin.**

→ Insoluble Klason lignin (dietary fiber method): at least 95% of the results are expected at ±10% of the true value.

→ Lignin VS (detergent fiber method): at least 95% of the results are expected at ±15% of the true value.

Bias assessment

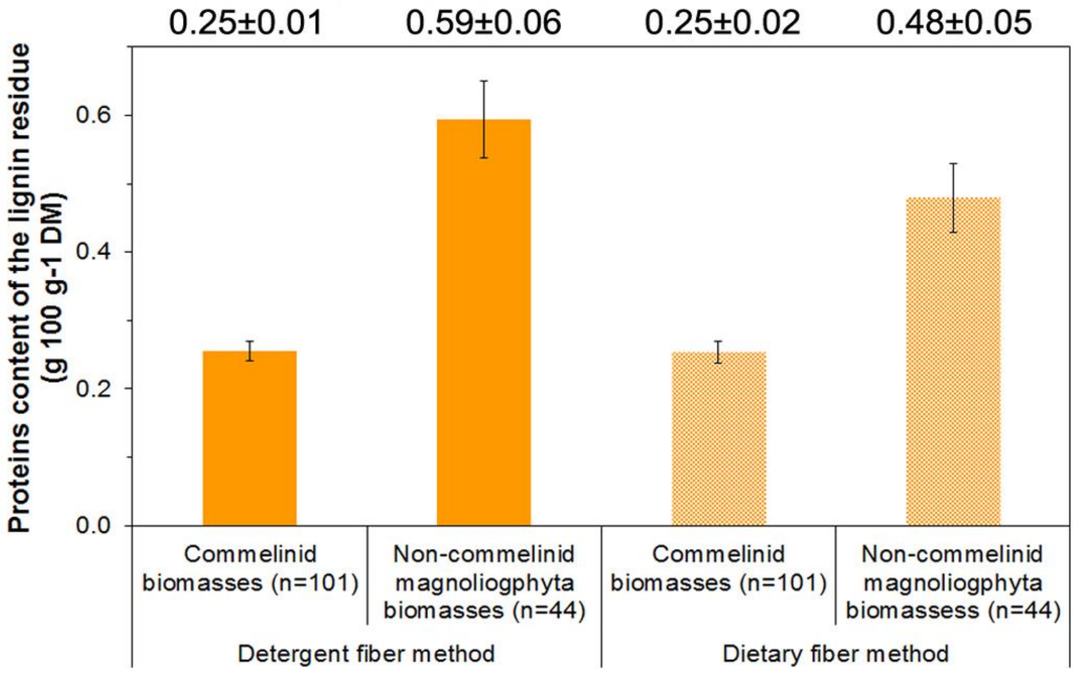
- The **regression of the lignin content** (corrected of proteins ; CP) between the two assessed methods have **good prediction performances** owing to their good R2 and RPD (values of R2≥0.90 and of RPD≥3.0) → **The bias between these methods is constant.**

→ Commelinid biomasses (n=101) : Insoluble Klason lignin=1.369xLignin VS + 2.39 ; R2=0.95 ; RPD=4.6 ; MRE=0.74

→ Non-commelinid magnoliophyta biomasses (n=44) : Insoluble Klason lignin=1.351xLignin VS + 0.46 ; R2=0.93 ; RPD=3.7 ; MRE=1.03

- **The lignin content corrected of its proteins content can be predicted quantitatively by the lignin content uncorrected of its proteins content.** The regression lines between these two parameters have excellent prediction performances owing to their excellent R2 and RPD (values of R2≥0.95 and of RPD≥4.0).

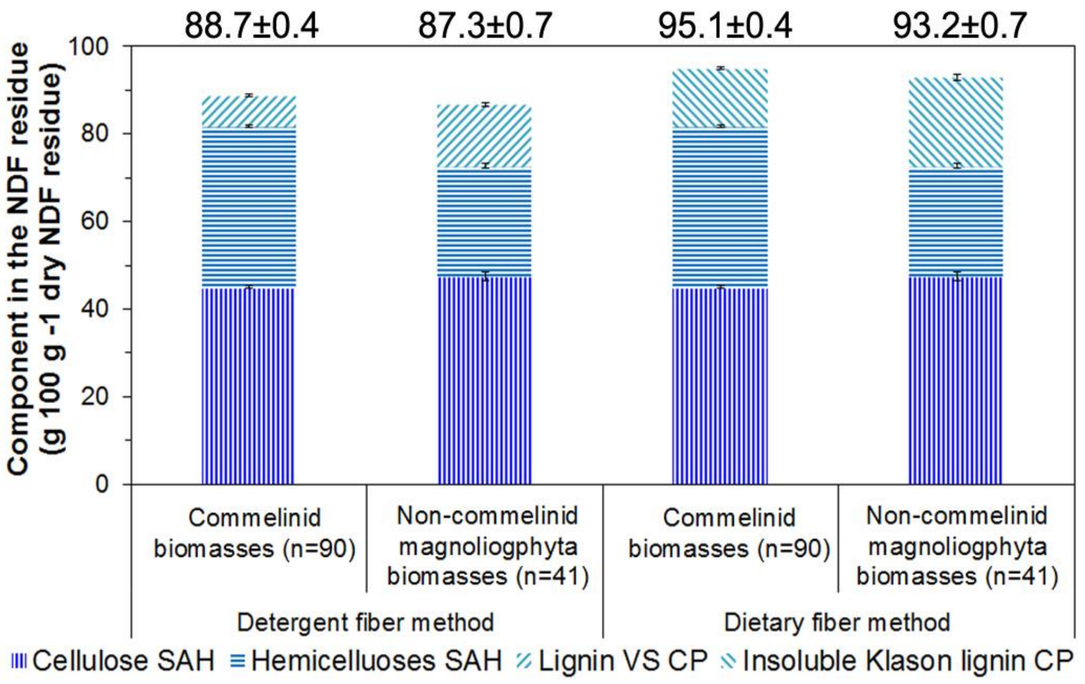
Proteins content of the lignin in the whole dry matter



- When the proteins content of the lignin residue is expressed relatively to the whole biomass, **the proteins contamination of the lignin residue is similar** (not significantly different) **for both methods.** This means that the residual proteins are probably strongly bonded to the lignin.

→ **The proteins contamination is the same for both methods.**

Mass balance of neutral detergent fiber residue (NDF)



- The balance of the neutral detergent fiber residue (NDF) shows that the **dietary fiber method has a higher balance** (nearer to 100%), as compared to the detergent fiber method.

→ **Dietary fiber method has a lower bias for the quantification of lignin.**

Conclusions

- We showed that the **dietary fiber method has the highest accuracy to quantify lignin** because of its higher precision and smaller bias, as compared to the detergent fiber method.
- Nevertheless, the less tedious and resource consuming **detergent fiber method** can **reliably** be used to **predict the results of the dietary fiber method** with the conversion factors determined in this poster. Owing to these conversion factors, **the detergent fiber method** can be used to rapidly and accurately **rank plant biomasses in the biofuel, bio-based chemicals and feed sectors**.

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