Modification of the chemical composition in cellulosic biomasses induced by torrefaction

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Introduction

● **Torrefying cellulosic biomasses**

→ **Produces a renewable fuel under the form of pellets comparable to mineral coal, both in terms of energy density and physicochemical characteristics**

→ **Increases the energy density by the decrease of water content and increase of carbon content**

● **The objectives of our study is to assess**

→ **Content change of the main chemical components (Lignin, Cellulose, Hemicelluloses, Solubles Sugars, Starch, Proteins and Mineral compounds)**

→ **Cellulosic biomasses (Bamboo, Spruce, Tall fescue, Corn and Sorghum)**

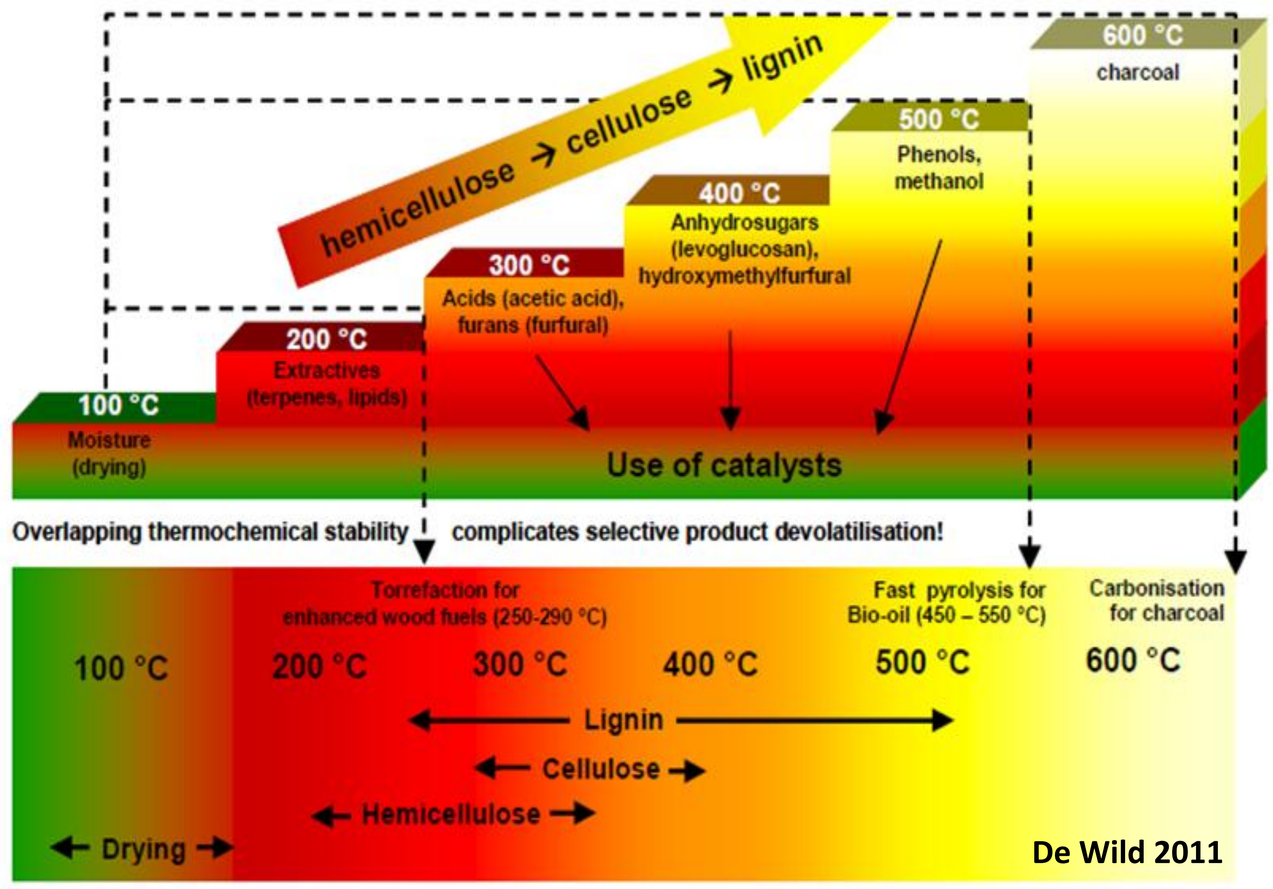
→ **Torrefaction at 270°C until a 25% loss of dry weight**

In addition, we assessed the suitability of the Van Soest method

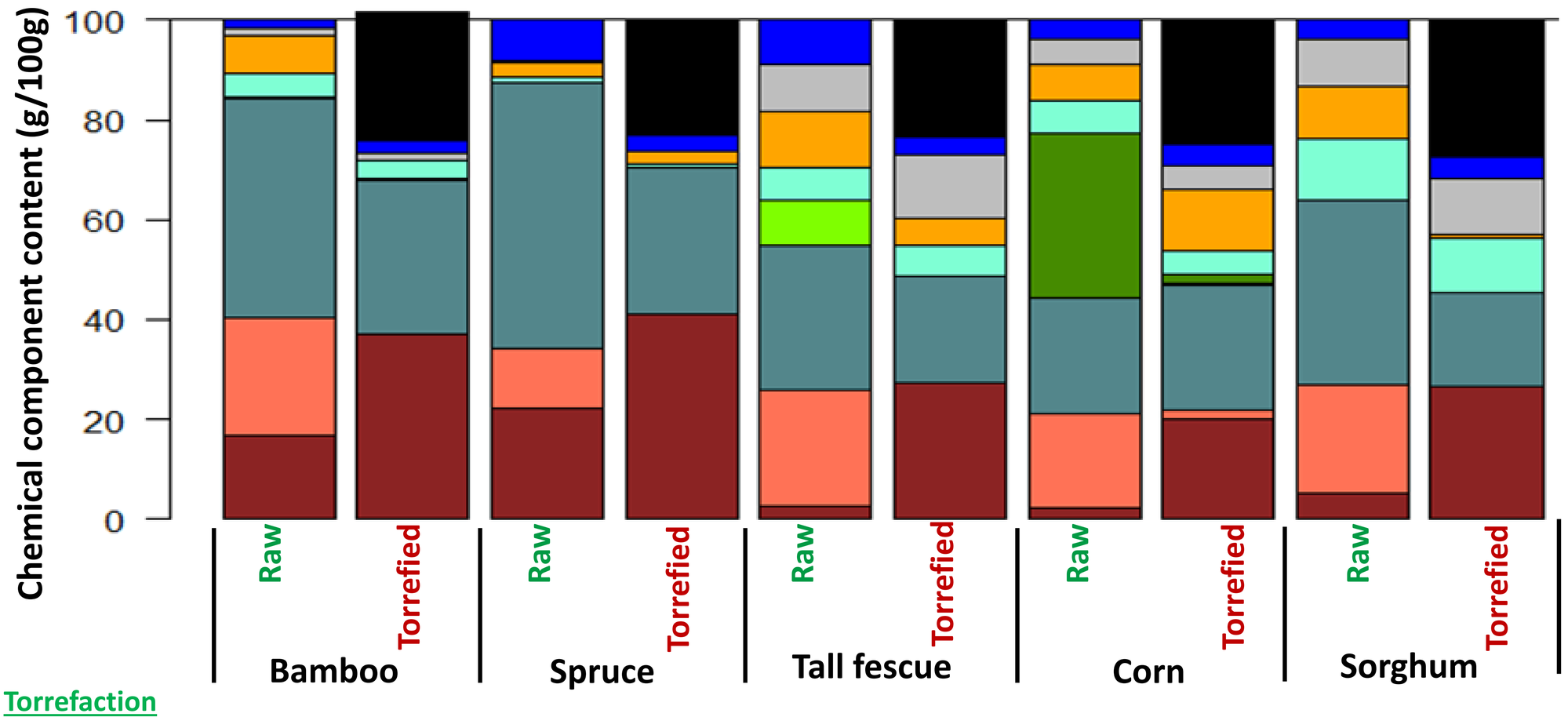
→ **Usually used to determine the content of lignin, cellulose and hemicelluloses in forage biomasses to be used with torrefied biomasses**

→ **NDF, ADF and ADL are 3 Van Soest fractions used to calculate content of lignin, cellulose and hemicelluloses**

Thermal degradation of chemical compounds



Chemical composition



Torrefaction

→ **Enables to have biomasses with a more standardized chemical composition and lower water content**

→ **Torrefaction concentrates mineral compounds**

→ **Completely degrades soluble sugars**

→ **Completely degrades starch → Into extractives**

→ **Partially degrades cellulose**

→ **Completely degrades hemicelluloses → Into lignin**

→ **Explained by the fact that hemicelluloses (C5 based sugars) are degraded to furfural that condense with lignin**

→ **For torrefaction, use cellulosic biomasses with high contents of lignin, cellulose and hemicelluloses and a low content of mineral compounds**

Van Soest Method

● **Contrary to cellulosic biomasses, it is necessary in torrefied biomasses to determine the protein content in the NDF, ADF and ADL Van Soest fractions to subtract it from each respective fraction to avoid biased Van Soest values of the lignin, cellulose and hemicelluloses contents.**

→ **Necessary for a higher degree of accuracy of the total mass balance of torrefied biomasses**

→ **Explained by the fact a thermal treatment like torrefaction make proteins insoluble and result in significant protein contamination in the NDF, ADF and ADL Van Soest fractions**