



The delignification effects of white-rot fungal pretreatment on thermal characteristics of moso bamboo

Yelin Zeng, Xuewei Yang, Hongbo Yu, Xiaoyu Zhang, Fuying Ma^{*}

Key Laboratory of Molecular Biophysics of MOE, College of Life Science and Technology, Huazhong University of Science and Technology, Wuhan 430074, PR China

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ABSTRACT

Moso bamboo (*Phyllostachys pubesescens*) is a major bamboo species which is widely used for temporary scaffolding in China. Its fast growing and low ash content make moso bamboo a potential renewable energy resource. In present work, thermal behaviors of moso bamboo and its lignocellulosic fractions were investigated using thermogravimetric analysis. Furthermore, to understand whether the delignification effect of white-rot fungi can promote the thermal decomposition of bamboo especially the lignin component, the changes in lignocellulose components as well as thermal behaviors of bamboo and acid detergent lignin were investigated. The results showed that the white-rot fungal pretreatment is advantageous to thermal decomposition of lignin in bamboo. The weight losses of ADL samples became greater and the thermal processes were accelerated after biopretreatment. The total pyrolysis weight loss increased from 57.14% to 65.07% for *Echinodontium taxodii* 2538 treated bamboo ADL sample.

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1. Introduction

The depletion of fossil fuels and climate changes have led to an increased interest in the development of thermal processing of sustainable biomass (Asif and Muneer, 2007; Haines et al., 2007). Pyrolysis is a promising thermochemical conversion route, converting biomass to energy-dense fuels and chemical feedstocks (Lu et al., 2009). Bamboo is a large woody grass of the tall graminaceous plants including 1250 species within 75 genera (Scurlock et al., 2000). Moso bamboo (*Phyllostachys pubesescens*) is a major bamboo species which is widely used for temporary scaffolding in China (Fu, 2001; Mui et al., 2008). Its fast growing, low ash content and alkali index make moso bamboo a potential renewable resource for obtaining biofuels. Furthermore, the heating value of bamboo is slightly lower than most woody biomass feedstocks but higher than most agricultural residues and grasses (Scurlock et al., 2000). However, there have been limited previous studies on the pyrolysis of bamboo, not to mention the thermal decomposition mechanism of individual lignocellulosic components in bamboo (Mui et al., 2008).

Lignin is a major component of biomass accounting for 17–32.5% of the mass of bamboo (Mui et al., 2008), which consists of phenylpropane units (Bridgwater et al., 1999). Besides, lignin is the major by-product of biomass ethanol production and a major impurity in the process of wood pulping and papermaking (Lynd et al., 1991; Messner and Srebotnik, 1994). Due to its aromatic structure, it is attracting to convert lignin into valuable aromatic hydrocarbons

for biofuels and chemicals (Clark, 2007). Some of the previous researches focused on product distribution from pyrolysis of lignin in order to achieve higher yields of phenol and phenolics (Jiang et al., 2010). Studying on the kinetics of biomass pyrolysis is important to better understand the underlying processes and to provide useful information for design and scaling-up of pyrolysis reactors (Jiang et al., 2010; Orfao et al., 1999).

Compared with pyrolysis of cellulose and hemicelluloses, lignin decomposes in an extensive temperature range with relatively low rates and is the principal source of the char (Bridgwater, 1999; Yang et al., 2006). It was hypothesized that the structure modification and degradation of lignin may make the lignin in biomass easier to thermal decomposition (Kim and Parker, 2008; McMillan, 1994; Yang et al., 2011). The lignin degrading white-rot fungi have been considered to be the most efficient microorganisms for biomass decomposition and depolymerization (Dinis et al., 2009). Pretreatment by white-rot fungi could efficiently convert the complex constituent of lignin to a relatively simple structure with mild conditions and low energy consumption (Sun and Cheng, 2002). In previous investigation, white-rot fungi *Irpex lacteus* CD2 and *Echinodontium taxodii* 2538 were found to have the ability to degrade biomass lignin (Yang et al., 2010; Yu et al., 2009). However, it is not yet known whether the delignification effect of white-rot fungal pretreatment can promote the thermal decomposition of bamboo and the lignin component.

The purpose of this study was to explore the thermal behaviors of moso bamboo and its lignocellulosic fractions using thermogravimetric analysis. Furthermore, to understand the influence of biopretreatment on the pyrolysis of bamboo, the thermogravimetric characteristics of bamboo pretreated by white-rot fungi were

^{*} Corresponding author. Tel.: +86 27 87792128.

E-mail address: mafuying@hust.edu.cn (F. Ma).