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Simultaneous pretreatment and sacchariffication of rice husk by *Phanerochete chrysosporium* for improved production of reducing sugars

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HIGHLIGHTS

- We made an attempt to avoid SSF of fungal pretreatment.
- One direct step for pretreatment of the reducing sugar production.
- Fungal pretreatment resulted higher amount of reducing sugars on day 18 (895.9 mg/2 g of substrate).

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ABSTRACT

Phanerochete chrysosporium, the white-rot fungus, (a best source for lignolytic enzymes system) was used in the biological pretreatment of rice husk for reducing sugars production. Usually reducing sugar production through biochemical process involves two steps: solid state fermentation (SSF) of fungal pretreatment for delignification, subsequently pretreated biomass subjected to enzymatic hydrolysis. During the fungal pretreatment of rice husk for reducing sugar production along with cellulase and xylanse, the activities of lignin degradation-related enzymes such as lignin peroxidases (LiP), GLOX (glyoxidase), and aryl alcohol oxidases (AAO), were observed. The fungal pretreated rice husk produced highest (895.9 mg/ml/2 g of rise husk) reducing sugars on 18th day of fungal treatment. This method may be good alternative to avoid operational costs associated with washing and the removal of inhibitors during the conventional pretreatment methods.

1. Introduction

Global energy demand is rising because of industrialization and population growth. By the 2030 it is forecasted that global energy demand increase by 43.64% from the current total of 472 quadrillion Btu to 678 quadrillion Btu. Fossil fuel depletion, environmental concerns and "food or fuel" controversy motivated towards effective utilization of agricultural lignocellulosic waste materials as a potential source for bioethanol production (Lim et al., 2012).

Rice is an important staple crop in many countries and is abundantly produced in many parts of the globe. Annually 465.078 MT of rice produced globally (United States Department of Agriculture Foreign Agricultural Service) and for every kilogram of harvested paddy 20–33% of (paddy weight) rice husk (RH) was generated (Lim et al., 2012). India is second largest producer of rice and annually produces 102.0 MT (Annual Report, 2011–12) of rice and about 20.4–33.6 MT of RH. In India RH commonly used as domestic and industrial fuel, sometimes it is burned in the fields. If 30% of total RH is utilized at 60% efficiency, it has the potential to fulfill the 75% of India's annual demand of ethanol for 10% blending with petrol (Banerjee et al., 2009). RH contains about 28.6% cellulose, 28.6% hemicellulose, 24.4% lignin, and 18.4% extractive matter (Worasuwannarak et al., 2007). The high ash content limits its pyrolysis efficiency. Abundance, lower cost and high ethanol yields make RH an excellent prospective raw material for future ethanol production. The complex structure of lignocellulosic biomass resists the degradation and limits biomass utilization for ethanol production (Zaldivar et al., 2001).

To overcome the recalcitrant nature of biomass pretreatment step plays a key role and breaks the complex structure in order to remove the pentoses and hexoses from hemicellulose. Pretreatment is one of the most expensive steps in the process of bioethanol production and contribute about 30% of the total cost (Yang and Wyman, 2008). An effective pretreatment should be economical, minimize the loss of sugars and maximize the lignin removal and finally limit the formation of inhibitors (Mosier et al., 2005).

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