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Short Communication

Potential of *Ceiba pentandra* (L.) Gaertn. (kapok fiber) as a resource for second generation bioethanol: Effect of various simple pretreatment methods on sugar production

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ABSTRACT

The importance of bioethanol currently has increased tremendously as it can reduce the total dependency on fossil-fuels, especially gasoline, in the transportation sector. In this study, *Ceiba pentandra* (kapok fiber) was introduced as a new resource for bioethanol production. The results of chemical composition analysis showed that the cellulose (alpha- and beta-) contents were 50.7%. The glucose composition of the fiber was 59.8%. The high glucose content indicated that kapok fiber is a potential substrate for bioethanol production. However, without a pretreatment, the kapok fiber only yielded 0.8% of reducing sugar by enzymatic hydrolysis. Thus, it is necessary to pre-treat the kapok fiber prior to hydrolysis. Taking into account environmentally friendliness, only simple pretreatments with minimum chemical or energy consumption was considered. It was interesting to see that by adopting merely water, acid and alkaline pretreatments, the yield of reducing sugar was increased to 39.1%, 85.2% and >100%, respectively.

1. Introduction

The rapid depletion of fossil fuels has driven the world to utilize renewable-energy sources such as biofuel in order to reduce the total dependency on fossil fuels. Recently, biofuel such as bioethanol has become an increasingly popular alternative fuel as it can be used to replace gasoline in the transportation sector. This is because almost 40% of the total energy consumption in the world is in the form of liquid fuel such as gasoline (Tan et al., 2008). However, first-generation bioethanol that is derived from edible sources, for instance, corn and sugarcane have resulted in competition with food supply. In this respect, bioethanol converted from non-edible sources such as lignocellulosic biomass, has offered a great promise to replace fossil fuels without causing the dispute of food–fuel supply. This kind of bioethanol is known as second generation bioethanol or cellulosic ethanol. Lignocellulosic biomass comprises mainly cellulose, hemicellulose and lignin. Cellulose, which is the major composition of the plant cell wall, can be degraded chemically or enzymatically into glucose, and subsequently fermented into ethanol.

Ceiba pentandra (L.) Gaertn. or commonly known as kapok fiber is a natural plant fiber, which is a silky, yellowish and cotton-like substance that surrounds the seeds in the pods of the kapok tree. Traditionally, kapok fibers are utilized as stuffing material for beds and pillows. Kapok fiber, similar like cotton consists of single cell fiber, which is mainly cellulose on its lignocellulosic system. However, as compared to kapok fibers, cotton has been extensively utilized for various applications. Recently, the utilization of cotton for the production of bioethanol was also established. (Jeihanipour and Taherzadeh, 2009). Hence, it is also possible to convert kapok fiber into ethanol in order to discover it on others' usability. In general, to produce bioethanol, the lignocellulosic biomass used should contain 40–50% of cellulose content. Since kapok fiber contains 35–64% of cellulose content (Kobayashi et al., 1977; Hori et al., 2000), it is possibly a high-potential resource for the production of cellulosic ethanol. Apart from that, kapok fiber is fine in nature, and so it can be used directly to produce ethanol without a refining pre-process. Hence, it may consume relatively lesser energy in comparison to other biomass in the production of ethanol, for instance woody biomass (eucalyptus) (Teramoto et al., 2008) and agricultural biomass (corn stover) (Li et al., 2010).

Enzymatic hydrolysis is an attractive hydrolysis step for the conversion of lignocellulosic biomass into glucose. However, several research findings have reported that the presence of recalcitrant polymers such as lignin and hemicellulose may hinder the hydrolysis of biomass (Alvira et al., 2010). Therefore, in order to improve the rate of enzymatic hydrolysis and to increase the yields of fermentable sugars, an appropriate pretreatment is required prior to the hydrolysis. Various advance pretreatment methods, such as steam explosion, sulfite, ammonia fiber expansion (AFEX)

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