INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Sustainable strategies to achieve an industrial titer of bioethanol from lignocellulosic biomass

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SHORT ABSTRACT

The current thesis emphasizes sustainable strategies to achieve an industrial titer of bioethanol production from lignocellulosic biomass via biochemical conversion route. Preliminarily, structural carbohydrates content of lignocellulosic materials has been analyzed for the assessment of bioethanol potential. As a result, around 269–329 g of theoretical bioethanol yield can be achieved per kg of various sorghum biomass traits. Further, dilute sulfuric acid pretreatment of sorghum biomass was performed for the maximization of pentose sugars yield with minimized levels of fermentative inhibitors. As a result, around 97.6% of hemicellulose hydrolysis was attained at 121 ºC, 0.2 M H_2SO_4 for 120 min. Furthermore, pre-hydrolyzate was neutralized with $Mg(OH)_2$ and it's subsequent fermentation results in 0.45 g_p/g_s ethanol yield and 88% ethanol conversion efficiency. Moreover, pretreated biomass was enzymatically hydrolyzed by cellulase for the optimization of glucose yield. Moreover, in order to decrease the citric acid inhibition effect on glucose fermenting yeast namely *Saccharomyces cerevisiae*, enzymatic hydrolysis of pretreated biomass was carried out at lower citrate buffer strengths (5 mM and 0.5 mM). The cellulose conversion efficiency results (54.4%) were found to be strongly agreeable with that of the standard enzymatic hydrolysis (50 mM) process. Due to the low cellulose conversion efficiency (54.4%), pretreated biomass was de-lignified prior to the enzymatic hydrolysis process. As a result, around 81%–98% lignin content was removed from the pretreated biomass. Subsequently, 99.6% of cellulose conversion efficiency was achieved during the enzymatic hydrolysis by employing 40 mg of cellulase protein/g of cellulose at 10% (w/v) solid loading. Furthermore, enzymatic hydrolyzate derived from 0.5 mM citrate buffer strength did not show any detrimental effect on glucose fermenting yeast which ultimately produced an industrial titer of 74.7 g/L ethanol with better ethanol yield (0.46 gp/gs) and ethanol conversion efficiency (90%).