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A COMPARISON STUDY OF DIFFERENT ACID PRETREATMENT TECHNIQUE ON THE REMOVAL OF LIGNIN AND REDUCING SUGAR PRODUCTION FROM DIFFERENT BIOMASS

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Abstract:

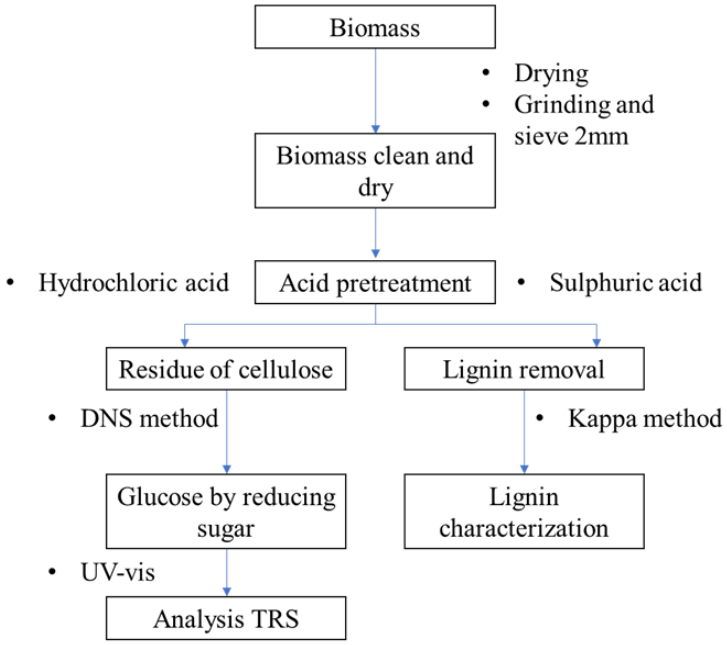
Lignocellulosic biomass included rice husks, corn cobs, oil palm, sugarcane bagasse, and bamboo are one of the abundant organic resources in most Asian countries. It basically consists of three fractions, cellulose, hemicelluloses, and lignin. The improper disposal method of biomass, such as open burning has led to environmental problems because of the smoke released to the air and reduced air quality. With that, pretreatment steps are required to make each fraction available for further use. This study was designed to compare the efficiency of sulphuric acid, H_2SO_4 and hydrochloric acid, HCl pretreatment on the removal of lignin, and total reducing sugar (TRS) production from different biomass. Since it is a comparative study, the data information was collected based on the previous study from Science Direct, Course Hero, Google Scholar, Sci-Hub, and Researh Gate. Determination of lignin removal by using Kappa Number and reducing sugars by 3,5-dinitrosalicylic acid (DNS) method was used. The input variables for each sample consisted of acid concentration, temperature, and solid loading in the range of 1% - 10%, 45˚C - 180˚C, and 1:1-1:10, respectively. The highest lignin removal is pretreated corn cobs that reduced to 90% lignin removal from 0.074g to 0.0085g/g after pretreatment. Process optimisation gave reducing sugar yields of 0.0751 and 0.096 g/L (rice husks), 24.7 and 81.8 g/L (corn cobs), 1.81 and 2.7 g/L (oil palm), 3.67 and 89.4 g/L (sugarcane bagasse), 0.319 and 0.93 g/L (bamboo) for H_2SO_4 and HCl pretreatments respectively. The maximum TRS yield reported about 89.4 g/L, sugarcane bagasse because the ability of HCl to permeate the lignocellulosic biomass more easily compared to H_2SO_4 pretreatment methods. The highest percentage of cellulose (corn cobs, 90.4%) was also observed with the HCl model. Besides, the optimised HCl pretreatment showed high efficiency at releasing reducing sugars from pretreated biomass.

***Keywords*:**
Lignocellulosic biomass, pretreatment, Kappa Number, lignin removal, reducing sugars

Objectives:

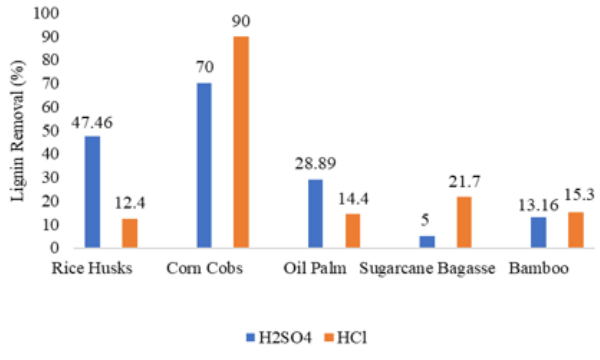
- To compare the efficiency of different types of acid pretreatment in the removal of lignin and reducing sugar production by evaluating pretreatment parameters such as concentration, solid loading, and temperature.
- To find the best and effective acid agents in acid pretreatment method in removing higher lignin with a high yield of reducing sugar production.

Methodology:

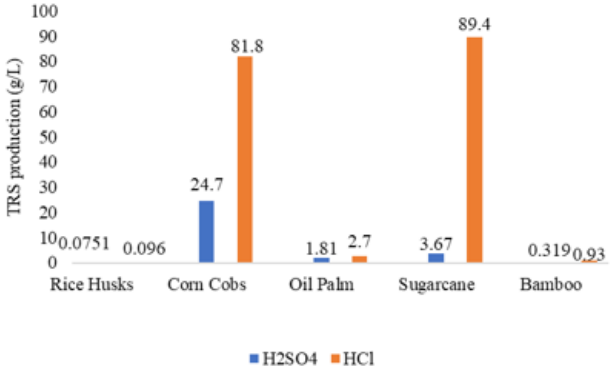


Results:

Lignin Removal



TRS Production



Conclusion:

From the studies towards the biomass wastes, it was concluded that biomass wastes show a high potential to be converted to a valuable product, which is reducing sugar. A diluted acid hydrolysis process was employed in order to perform a moderate reaction condition with ambient temperature and acid concentration. It is also can conclude, dilute HCl pretreatment of different biomass in liquid media was an effective acid agent that reported about 90% of lignin removal at lower concentration (1%, HCl) and relatively lower temperature (100˚C to 108˚C). Pretreatment at 180°C gives the highest sugar recovery due to the optimum balance between xylan solubilization and cellulose hydrolysis. Effective conversion of lignocellulosic biomass to reducing sugars is not only limited to the selection of the most efficient pre-treatment technique. Factors like biomass type and collection period, size, preparatory reagents, and treatment conditions affect the outcome. Besides that, the reason for the improvement in the yields of reducing sugars due to HC1 pretreatment because it can cleave some of the C-O-C linkages of lignocellulosic structure. Moreover, HCl pretreatment might also loosen the structure of biomass residues.