COMBINED DILUTE ACID AND ALKALINE PRETREATMENTS FOR EFFICIENT ENZYMATIC HYDROLYSIS OF WHEAT STRAW

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Introduction. Biofuels are obtained from lignocellulosic matter and represent a promising alternative to fossil fuels. Dilute acid pretreatment solubilize hemicellulose with high conversion yields [1]. Several studies have confirmed that lignin acts as a physical barrier restricting cellulase access to cellulose and reduce enzymatic activity [2]. Dilute alkaline pretreatment delignifies lignocellulosic biomass, therefore combined pretreatments may be a promising strategy in order to establish an economical process with high sugar recovery [3]. The aim of this work was to establish the best alkaline pretreatment conditions after dilute acid pretreatment in order to maximize saccharification yields and enzymatic effectiveness.

Methods. Wheat straw was used as raw material. Dilute acid pretreatment (DAP) was according to Saha *et al*., (2005) [1]. Alkali pretreatment (AKP) was performed with NaOH at (0.25 - 3%; w/v), temperatures (60 - 121°C), and times (5 - 60 min); solids load of experimental units was 7.83% (w/v). RSM was used to create the experimental design. Enzymatic hydrolysis was performed with Accellerase 1500 (17 FPU/g solid). Experimental units at a solid load of 4% (w/v) incubated at 50°C, 200 rpm for 48h. Glucose and xylose were quantified by an YSI 2700.

Results. Even though lignin was not quantified, an increase in total yields from 64 to 88.9% was observed with sequential pretreatments. Alkali concentration had an important effect in total yields, whereas time factor was not as evident. Although time slightly affects yields at high concentrations, having a maximum yield at 60 min, high yields are also found at short alkali pretreatment times. Design Expert was used to analyze the results, and a quadratic model was generated (Fig. 1), alkali and its interaction with temperature were significant factors (coefficients of 0.083 and 0.056, respectively). In order to evaluate sequential pretreatment effectiveness, enzymatic effectiveness was proposed as ($mg_{glucose}$/FPU). A higher value of 42.35 $mg_{glucose}$/FPU was found, compared with those reported in a previous work [4] (Fig. 2). Total carbohydrate conversion found was 1.39 and 1.2 times higher than those reported by Saha *et al.*, (2005) [1] and by Rojas-Rejón *et al.*, (2012) [4], respectively.

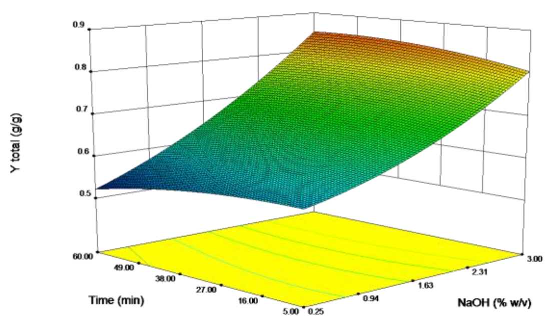

Fig.1 Response surface of total polysaccharide conversion to monosaccharide at 121°C.

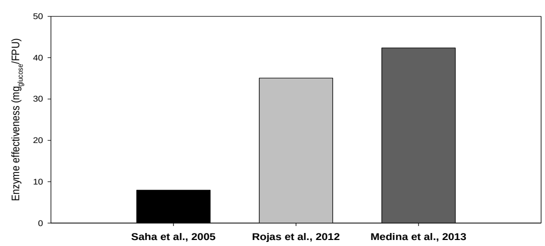

Fig.2 Comparison of pretreatments on total carbohydrate converted and enzymatic effectiveness.

Conclusion. Combined acid-alkaline pretreatments had a remarkable positive effect on the enzymatic saccharification, improving yields and enzymatic effectiveness.

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