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Comparison, modeling and simulation of enzymatic saccharification on olive tree biomass under dilute acid and autohydrolysis pretreatment

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Bioethanol can be produced from pretreated olive tree biomass (OTB) followed by enzymatic hydrolysis and fermentation. In order to obtain high overall ethanol yield, the pretreatment step should improve the accessibility of cellulose to hydrolytic enzymes. The modeling and simulation of enzymatic hydrolysis pretreated solids obtained by diluted acid (DA) and autohydrolysis (AH) were studied. The assumptions of the first and second order model of cellulase deactivation are: 1) a single combined effect in the hydrolysis of insoluble substrate; 2) surface structure of insoluble substrate was considered homogeneous. The reactions of enzymatic hydrolysis were performed in 0.05 M sodium citrate buffer (pH = 4.8) at 50 ºC on a rotatory shaker at 150 rpm using commercial cellulase and β-glucosidase with loadings of 15 FPU/g and 15 IU/g of substrate, respectively. Samples were taken at 24 h intervals until a total of 72 h. The content of glucose in the liquid was quantified by an enzymatic glucose kit. The maximum initial rates defined as the slope were 0.1, 0.48 and 0.41 g/(L h) for untreated, DA and AH of pretreated OTB. The experimental glucose production of the enzymatic hydrolysis of DA and AH, was fitted corresponding to the first and second order kinetic models. In all cases, a good agreement was obtained ($R^2 > 0.98$). The model based on the second order kinetics was accurate on the description of the enzymatic hydrolysis of all the studied substrates. This model can provide useful indications for the optimization of the enzymatic hydrolysis.