ABSTRACT

Casey, Elizabeth Rebecca. MS ABE, Purdue University, December, 2008. Effect of Acetic Acid under Controlled pH Conditions on the Co-fermentation of Glucose and Xylose by *S. cerevisiae* 424A(LNH-ST). Major Professor: Nathan Mosier.

One of the primary obstacles facing the cellulosic biomass to ethanol industry is the effect of inhibitors present in biomass hydrolysates on the fermentation of these hydrolysates to ethanol. The focus of this thesis is on the effect of acetic acid, an inhibitor released during the pretreatment of hemicellulose, on the co-fermentation of glucose and xylose under controlled pH conditions by *S. cerevisiae* 424A(LNH-ST), a genetically engineered yeast strain. Acetic acid concentrations up to 15 g/L were tested over a pH range of 5-6. The presence of acetic acid in the fermentation media was shown to inhibit biomass growth, substrate consumption, and ethanol productivity, while improving the metabolic ethanol yield.

The maximum biomass concentration exhibited an approximate linear decrease with increasing acetic acid concentration for a given pH value. The growth during xylose fermentation, rather than glucose fermentation, appeared to be the most sensitive to acetic acid. Under the conditions tested, glucose consumption was virtually unchanged; however, xylose consumption was strongly inhibited by the presence of acetic acid. Decreasing the media pH (without acetic acid present) was also shown to decrease the xylose consumption rate. A Monod-type model for xylose consumption was developed and included an exponential decay inhibition term dependent on pH and acetic acid concentration. The ethanol

production rate was also negatively affected by acetic acid; a decrease in the volumetric ethanol productivity was seen with increasing acetic acid concentration. However, the metabolic ethanol yield increased as acetic acid concentration increased.