

The Impact of Electron Beam Pre-treatment on the Fermentation of Wood-based Sugars

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Lignocellulosic biomass has the potential to be a major source of biomass-derived fuel products. However, the protective matrix of polymeric materials incorporated in lignocellulosic biomass, called recalcitrance, must be deconstructed in order for utilization. This requires efficient pretreatment before wood-based polymers can be converted to sugars which are useful in fermentation to fuels or other end products. Preliminary studies on high energy electron beam (HEEB) irradiation as a pretreatment of hardwood, along with hot water extraction, yield results that show enhancement in the rate and yield of enzymatic conversion of wood to sugars and subsequent fermentation. This project explores if a similar enhancement effect is seen in the fermentation of HEEB pretreated softwoods, such as red pine, and if a similar effect is demonstrated in butanol-producing fermentation using *Clostridium acetobutylicum*. Fermentation results are monitored using near-infrared (NIR) spectroscopy models designed for this project for the prediction of glucose consumption and ethanol/butanol production. The underlying component of the enhancement effect is also being investigated with respect to soluble ion concentrations after HEEB irradiation. The optimization of pretreatment protocol of woody biomass holds environmental, economic, and scientific value; maximizing the rate and yield of sugar conversion and fermentation production will lead to significant advancement in the manufacture of biofuels.

Keywords: biomass energy, biomass pretreatment, cellulose, electron beam irradiation, lignocellulosic biomass