Title: A High Solids Field-To-Fuel Research Pipeline to Identify Interactions Between Feedstocks and Biofuel Production

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Project Goals:

- To develop a laboratory-scale high solids field-to-fuel platform to evaluate fermentation performance of diverse feedstocks
- To achieve a higher throughput to process the large number of samples from agronomic studies

Abstract Text:

Environmental factors, such as weather extremes, have the potential to cause adverse effects on plant biomass quality and quantity. Beyond adversely affecting feedstock yield and composition, which have been extensively studied, environmental factors can have detrimental effects on saccharification and fermentation processes in biofuel production. Only a few studies have evaluated the effect of these factors on biomass deconstruction into biofuel and resulting fuel yields. This field-to-fuel evaluation of various feedstocks requires rigorous coordination of pretreatment, enzymatic hydrolysis, and fermentation experiments, which led to the need for a laboratory-scale high solids experimentation platform. A field-to-fuel platform was developed to provide sufficient volumes of high solids loading enzymatic hydrolysate for fermentation. AFEX pretreatment was conducted in custom pretreatment reactors, followed by high solids enzymatic hydrolysis. To accommodate enzymatic hydrolysis of multiple samples, roller bottles were used to overcome the bottlenecks of mixing and reduced sugar yields at high solids loading, while allowing greater sample throughput than possible in bioreactors. The roller bottle method provided 42–47% greater liquefaction compared to the batch shake flask method for the same solids loading. In fermentation experiments, hydrolysates from roller bottles were fermented more rapidly, with greater xylose consumption, but lower final ethanol yields and CO_2 production than hydrolysates generated with shake flasks. The entire platform was tested and was able to replicate patterns of fermentation inhibition previously observed for experiments conducted in larger-scale reactors and bioreactors, showing divergent fermentation patterns for drought and normal year switchgrass hydrolysates. Thus, pipeline of small-scale AFEX

pretreatment and roller bottle enzymatic hydrolysis can be effectively utilized to compare divergent feedstocks and diverse process conditions.

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