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Session 1B

Enzyme Catalysis and Engineering

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Lignocellulosic biomass is a valuable and plentiful feedstock commodity and its high cellulose and hemicellulose content (about 80% of total) provides considerable potential for inexpensive sugars production. However, enzymatic deconstruction of these polysaccharides remains a costly prospect. Strides in cellulase cost reduction have been made, yet further improvements are needed to reach the goal of $0.10/gal of EtOH expected to enable this new industry. Strategies to reach this goal will combine reduction in the cost to produce the needed enzymes as well as efforts to increase enzyme efficiency (specific activity). As this work proceeds, the more easily attained achievements will be made first, and thus the overall difficulty increases with time.

This session focused on aspects of cellulase and xylanase biochemistry needed for enhanced utilization of enzyme cocktails for bioconversion research. Fundamental studies of enzymatic action are critical to mid- and long-term success and were the subject of most presentations. Session speakers described advances in cellulase enzyme discovery, engineering, cocktail refinement, computer modeling, and active site biochemistry. Studies of enzyme production, discovery, synergism, engineering, and structure/function were also discussed. Work to select xylanases for treatment of hemicelluloses in biomass was presented as well, and these studies of relevant "accessory" enzymes are historically less well recognized than the cellulase work. Hemicellulose and lignin are now known to act as shields to cellulase action, so if hemicellulose can be degraded enzymatically, cellulase loading and pretreatment severity may be reduced. It was also concluded that we must continue to gain a better understanding of the relevant nature of biomass ultrastructure and anatomy. Such knowledge, gained primarily through application of new surface analysis tools, is necessary to design more effective pretreatments and enzyme cocktails.

The work presented by Tim Dodge (Genencor International), Elena Vlasenko (Novozymes Biotech), Brian Steer (Diversa Corporation), David Wilson (Cornell University), Tauna Rignall (Colorado School of Mines), and James Preston (University of Florida) collectively demonstrated the application of cutting-edge methodologies in biotechnology to reducing enzyme cost.

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