Conversion and Co-products Research at the Southern Regional Research Center (SRRC)

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Many of the research efforts at SRRC have relevance for conversion of cellulosic and co-products development.

- Most cellulosic enzymes are fungal in origin; however, other biological system may offer sources with higher-rate enzymes. SRRC researchers have cloned cellulase genes from termite saliva and expressed them in bacteria. Additional work will focus on termite gut enzymes. These cellulosic enzymes may offer advantages over commercial variants. (Contact: Alan Lax, alax@srrc.ars.usda.gov)

- Enzyme cost represents a significant factor in the cellulosic bioconversion area. In preliminary work, SRRC researchers have demonstrated that the enzymatic rate of cellulose hydrolysis can be increased by 35%-100% through the supply of sonochemical energy. Greater rates imply that less enzyme could be needed to reach the same endpoint in the same amount of time. Preliminary discussions with enzyme manufacturers reveal interest in this technology. (Contact: Brian Condon)

- The desire of carrying out simultaneous saccharification and fermentation is limited by the optimal environmental conditions for each operation. SRRC researchers have been able to alter the temperature and pH optima of other (than cellulases) hydrolytic enzymes by site-specific mutations of the amino acid sequence. Tailor-made saccharification enzymes would be extremely efficient for co-current enzyme-fermentation applications such as cellulosic conversion. (Contact: Thomas Klasson)

- Biodiesel (methyl esters of fatty acids) experience freezing in cold climates and thus blends are used. SRRC have been able to add aliphatic and aromatic groups to the double bonds of the oleic acid methyl ester, lowering the freezing temperature 30 degrees Centigrade. The branched chain fatty acid methyl ester could likely be used as an additive to biodiesel blends, improving performance at lower temperatures. (Contact: Thomas Klasson)

- Animal by-products (e.g., manure) and plant by-products (e.g., shells and hulls) can be used for pyrolysis/gasification and subsequent conversion. SRRC researchers have made products (e.g., chars and activated carbons) from the co-products of pyrolysis that have better metal adsorptive properties than commercial activated carbons. The gas/condensable liquids from pyrolysis are being investigated for its fuel value. Activated carbons from renewable by-product sources support sustainability. Contact: Thomas Klasson)

- The practical implementation of fuel alcohol fermentations from lignocellulosic materials will likely incur problems such as bacterial contamination and competition from wild strains of yeast. SRRC researchers in collaboration with Brazilian researchers have identified mannitol as an indicator of bacterial contamination in fuel alcohol fermentations from sugarcane juice or molasses. While SRRC is developing a mannitol assay to account for losses in sugarcane processing mills (due to bacteria and yeast), the technology will also benefit the fuel alcohol industry. (Contact: Thomas Klasson)

- With a bioenergy and bio-product industry based on the sugar platform, fermentations will generate a large quantity of yeast (or bacteria) as a co-product. One way to lower the cost of ethanol production from lignocellulosic biomass is to co-produce (within the yeast) an industrial enzyme to help offset the cost. (Contact: Thomas Klasson)

- Heavy use of bioenergy crops will likely result in the heavy use of fertilizers (NPK) resulting in potential runoff problems and associated environmental issues. SRRC researchers collaborated with scientists in Australia to express a phytase enzyme in the roots of plant cultivars. These cultivars could then extract bound phosphorous (as phytic acid) from the soil. A bioenergy crop with this capability could potentially reduce the use of phosphorous fertilizer and could have a positive environmental impact. (Contact: Thomas Klasson)