Characterizing Lignocellulosics from Pine to Bioethanol

Poulomi Sannigrahi and Arthur J. Ragauskas
School of Chemistry and Biochemistry
Georgia Institute of Technology
Atlanta, GA

INTRODUCTION
The efficient processing of lignocellulosics into bioethanol is contingent on the characterization of the chemical constituents of plant carbohydrates and lignin and their changes in structure throughout the process. This program will evaluate the impact of process chemistry for three different biomass resources. The first year of this research program focused on a softwood biomass resource Loblolly Pine, while the second year is focused on the hardwood feedstock Sweetgum. Highlights of results from FY 2006-2007 are presented here along with comparison of the two different biomass feedstocks.

BIOMASS FEEDSTOCK
- Widely prevalent softwood species in Eastern US
- Used for lumber, furniture, pulpwood and plywood
- Mature tree from Baldwin Co., GA sectioned, debarked and chipped
- Chips stored at < -5 °C
- Composite sample used for all analyses

LOBLOLLY PINE vs. SWEETGUM

RESULTS: Enzyme hydrolysis and fermentation of Pine

CONCLUSIONS: Loblolly Pine
- Organo-solv pretreatment is most effective
  - Supported by SEM and chemical analysis
  - Effects of pretreatments
    - Decrease in ash
      - Pretreatments effectively remove metals
      - Increased condensation of lignin
      - Lignin molecular weight decreases
      - Generate new ‘extractives’
      - Change in cellulose ultrastructure
  - Effects of enzyme hydrolysis
    - Increased cellulose crystallinity index
      - Preferential removal of amorphous cellulose
  - Data suggests need to develop enzyme capable of degrading more stable cellulose forms (eg. Iβ)