^{13}C Labeling and NMR Analysis: Critical Tools in the Development of Next Generation Biofuel Platforms

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Project Goals: The BioEnergy Science Center (BESC) is focused on the fundamental understanding and elimination of biomass recalcitrance. BESC's approach to improve accessibility to the sugars within biomass involves 1) designing plant cell walls for rapid deconstruction and 2) developing multitalented microbes for converting plant biomass into biofuels in a single step (consolidated bioprocessing). BESC researchers in characterization, modeling, and data management areas are engaged in 1) applying advanced technologies to analyze chemical and structural changes within biomass and 2) storing, tracking, analyzing and integrating data and understanding across the Center.

The economics of next generation biorefineries and biofuel, biomaterial production is extremely dependent on the overall yields and energy/material cost associated with biomass deconstruction. Therefore, it is important to gain a detailed understanding of the physico-chemical structure of the cell wall, mechanisms of efficiently overcoming biomass recalcitrance and methods of biomass deconstruction/conversion. A major component of our recent research program has been the development of a NMR toolkit utilizing partial or uniform ^{13}C isotopic enrichment. The elegance of this system resides in the fact any analysis of conversion processes or biomass-derived material will also benefit from this labeling. Untreated and pretreated corn stover stems along with the resulting continuous flow pretreatment reactor effluent were subjected to various ^{13}C 1D and 2D solution and solid-state NMR techniques to demonstrate the usefulness of ^{13}C labeling in biofuel research including high-throughput screening, *in-situ* destruction studies, metabolite analysis and cell wall 3D ultrastructural characterization.

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