Arthur J Ragauskas, J Fundam Renewable Energy Appl 2018, Volume 8
DOI: 10.4172/2090-4541-C4-058

# 11th World Bioenergy Congress and Expo

July 02-04, 2018 | Berlin, Germany

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## Next generation of low recalcitrance plants for biofuels

The recalcitrance of biomass is one of the greatest difficulties in the overall conversion of biomass to biofuels. To-date this requires costly pretreatment technologies that frequently lead to the generation of fermentation inhibitors and waste streams that need be treated in an environmental acceptable manner, incurring additional costs. The minimization of native biomass recalcitrance is clearly related to tailoring the structure of the starting bioresource (1) over the past decade, we have examined what plant cell parameters are involved in plant recalcitrance and have clearly determined that this is a multi-structural feature involving cellulose ultrastructure/degree of polymerization (DP), hemicellulose content and structure, lignin structure and content, lignin-carbohydrate complexes and plant cell wall accessibility. But it is also clear not all these parameters are of equal importance (2). examining the structural fidelity of 'wild' popular resources, we were able to demonstrate that the structure of lignin plays a key component in the overall recalcitrance of this feedstock, of special significance was the nature of inter-unit lignin bonding structures along with the structure of hemicelluloses. Both of these components undergo significant changes when undergoing acidic pretreatments which provide a biomass with increased accessibility and reactivity to cellulose. This presentation will examine the plant cell features and the advances in analytical chemistry needed to examine these features. These advances in the understanding of biomass recalcitrance have now facilitated key advances in accelerated engineering of low-recalcitrance plants that have now been developed in green house and controlled farm sites. In both case, the design of plants with low-reactance cell wall features has been demonstrated which in turn results in higher biofuel yields from a cellulose den construction/fermentation approach. Recommendations are made for next generation of plants will lower costs and improve the overall conversion of biomass to biofuels.

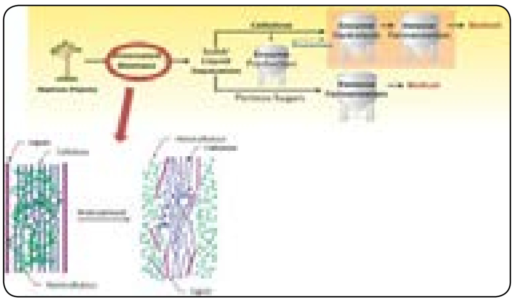

**Figure1:** Fundamentals of biomass recalcitrance

### Recent Publications

1. Meng X, Yoo C G, Li M and Ragauskas A J (2016) Physicochemical structural changes of cellulosic substrates during enzymatic saccharification. J Appl. Biotechnol. Bioeng. 1(3):00015.
2. Meng X et al. (2017) An in-depth understanding of biomass recalcitrance using natural poplar variants as the feedstock. ChemSusChem. 10(1):139-150.
3. Li M et al. (2017) Study of traits and recalcitrance reduction of field-grown COMT down-regulated switchgrass. Biotechnology for Biofuels. 10:12.

4. Meng X et al. (2016) Physicochemical structural changes of poplar and switchgrass during biomass pretreatment and enzymatic hydrolysis. ACS Sustainable Chemistry and Engineering. 4(9):4563-4572.
5. Yoo C G et al. (2016) Elucidating structural characteristics of biomass using solution-state 2D NMR with a mixture of deuterated dimethylsulfoxide and hexamethylphosphoramide. ChemSusChem 9(10):1090-1095.


## Biography

Arthur Ragauskas held the first Fulbright Chair in Alternative Energy and is a Fellow of American Association for the Advancement of Science, the International Academy of Wood Science and The Technical Association of Pulp and Paper Industry (TAPPI). In 2014, he assumed a Governor's Chair for Biorefining based in University of Tennessee's (UT) Department of Chemical and Biomolecular Engineering, with a complementary appointment in the UT Institute of Agriculture's Department of Forestry, Wildlife, and Fisheries and serves in the US Energy and Environmental Sciences Directorate, Biosciences Division, at Oak Ridge National Laboratory. His research program is directed at understanding and exploiting innovative sustainable bioresources. This multifaceted program is targeted to develop new and improved applications for nature's premiere renewable biopolymers for biofuels, biopower, and bio-based materials and chemicals. He is the Recipient of the 2014 TAPPI Gunnar Nicholson Gold Medal Award, ACS Affordable Green Chemistry Award and 2017 Green Process Engineering American Institute of Chemical Engineers.

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