UNIVERSITY OF FLORIDA

Biocatalytic Lignin Modification for Carbon Sequestration

PI: Jon Stewart
Students: Bradford Sullivan (postdoctoral fellow)

Description: After cellulose, lignin is the second most abundant forma of carbon in plants. Lignin's complex structure makes it difficult to use this material in value-added products, and ahte vast majority of lignin is currently burned to provide energy for factory operations. While burning plant derived lignin does not add to global greenhouse gas levels, having options to remove lignin from the global carbon cycle would lead to diminished atmospheric CO2 levels. This could be accomplished by chemically altering lignin's structure to facilitate long-term terrestrial sequestration or using it in value-added products that would not be discarded immediately. We will use Nature's catalysts (enzymes) to tailor the chemical structure of lignin for both deep-well injection (by using lignin derivatives as drilling "muds") and for materials that can be used in building, packaging, and other manufactured products.)

Budget: $200,000
Universities: UF

Progress Summary

Bradford Sullivan joined this project as a postdoctoral fellow in February 2010 with extensive experience in both organic synthesis and in dioxygenase enzymes. To the best of our knowledge, no one has applied dioxygenases to lignin and/or lignin model compounds. Enzymes such as toluene dioxygenase offer the possibility of converting this renewable feedstock into valuable building blocks. In preliminary studies, Brad has applied toluene dioxygenase to model compounds derivable from lignin to create small molecule mediators required by laccases for lignin breakdown. Some reaction was observed. We are also setting up a collaboration between our lab and those of Steven Sherman and Charles Turick (Savannah River National Laboratory), who have developed a simple method for lignin extraction from a variety of soft materials such as switchgrass as well as woody tissues. This will provide us with the material for exploring ionic liquids and deep eutectic solvents for laccase-catalyzed lignin conversions.

Funds leveraged/new partnerships created

New collaborations		
Steven Sherman, Charles Turick (Savannah River National Laboratory)	Steve and Chuck have agreed to supply us with lignin samples prepared in their lab using a newly-developed extraction method. This product stream will be employed for enzyme-catalyzed reactions in our lab using safe, non-volatile solvents (ionic liquids and deep eutectic solvents)	No external funding yet for this work

Proposals						
Title	**Agency**	**Ref #**	**Investigators/ Collaborators**	**Funding requested**	**Duration**	**Date submitted**
Adapting Kernel Metabolism to Enhance Cereal Yield Under Adverse Conditions	USDA	2011-67003-30215	L. Curtis Hannah (P.I.), Tracy Hennen-Bierwagen (co-P.I.), Karen Koch (co-P.I.), Don McCarty (co-P.I.), Alan Meyers (co-P.I.), Mark Settles (co-P.I.), Jon Stewart (co-P.I.), William Tracy (co-P.I.)	$5M	5 years	June 2010
Improving Alkene Reductases for Applications in Asymmetric Synthesis	NSF	NSF 10-1	Jon Stewart (P.I.)	T497,851	3 years	December 2010

Grants Awarded						
Title	**Agency**	**Ref #**	**Investigators/ Collaborators**	**Period of Performance**	**Funding awarded**	**Start Date**
Adapting Kernel Metabolism to Enhance Cereal Yield Under Adverse Conditions	USDA	2011-67003-30215	L. Curtis Hannah (P.I.), Tracy Hennen-Bierwagen (co-P.I.), Karen Koch (co-P.I.), Don McCarty (co-P.I.), Alan Meyers (co-P.I.), Mark Settles (co-P.I.), Jon Stewart (co-P.I.), William Tracy (co-P.I.)	5 years	$5M	June 2010