


Development of Sustainable Biobased Products and Bioenergy in Cooperation with the Midwest Consortium for Sustainable Biobased Products and Energy

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Midwest Consortium for Biobased Products & Bioenergy



Project Goals

1. Integrate institutional capabilities of the Midwest Consortium to add value to Distillers Grains (DG)

2. Carry out research to process DG
   - Additional fermentable sugars and ethanol
   - Obtain a protein enriched solid residue

3. Contribute directly to the DOE's multi-year plan as relates to the sugar platform and product
   - Help to ensure that the DOE meets targets to establish biomass as a significant source of sustainable fuels in the US



Objectives

1. Conduct research on the pretreatment fundamentals, enzyme catalysts, and microbial systems for converting both starch and cellulosic materials to ethanol at conditions consistent with the operation of a dry mill including economic models;

2. Carry out fundamental studies on the structure and function of hydrolytic enzyme, biomimetic, and organic catalysts with respect to the structure and function of the cellulose and hemicellulose in corn fiber and corn stover that enhances their conversion to sugar; and where it makes sense;

3. Partner with regional ethanol producers and government agencies to achieve sustainable systems for renewable bioenergy and bioproducts by defining engineering fundamentals for utilizing lignocellulosics and fiber materials as feedstocks in dry mills.


Technologies around which research of the Midwest Consortium will develop

1. Advanced pretreatments to enhance the digestibility/reactivity of the fiber component (cellulose and hemicellulose) of DG;

2. Enzymatic and biomimetic hydrolysis of pretreated DG and corn residue (stalks and leaves) to produce fermentable sugars and selectively remove part or all of the cellulose and hemicellulose, and thereby increasing the protein and feed value of the residual unhydrolyzed solids;

3. Conversion of these sugars to ethanol and other biobased products;

4. Identification and development of appropriate separation methods for improving the efficiency of sugar fermentations; and

5. Analysis of the regional economic and environmental impact of implementation of new technologies by dry mill plants.

Production of DDGS

- Corn is cleaned, tempered, ground into appropriate size, cooked, hydrolyzed with amylolytic enzymes and fermented with Yeasts.
- Ethanol and carbon dioxide are produced
- Distiller's wet grains and solubles are the residues remaining after fermentation
- These fractions are blended and dried to produce distiller's dried grains (DDG) or DDG with solubles (DDGS)


DDG Composition

Gross Matter		Average (95% confidence intervals)
Composition	Moisture Content (% total)	**11.2 ± 0.6%**
	Dry Matter Content (% total)	**88.8 ± 0.6%**
Dry Matter		
Composition	Ethanol Extractables (% dry matter)	**10.7%**
	Glucan (total) (% dry matter)	**20.9 ± 7.1%**
	Cellulose (% dry matter)	**16.0 ± 6.6%**
	Starch (% dry matter)	**5.2 ± 1.0%**
	Xylan (% dry matter)	**8.2 ± 3.3%**
	Arabinan (% dry matter)	**5.3 ± 0.7%**
	Protein (% dry matter)	**26.4%**
	Total Dry Matter Mass Closure	**92.7%**



Goals of Meeting

Provide window to future for adding value to DG and DDGS from dry grind ethanol production (3 to 10 year timeframe)

- focus on fundamental research on biotechnology, biocatalysis, biobased processing with retrofit potential
- utilize cellulose pretreatment and conversion technology
- partner and network with industry

Obtain input from regional ethanol producers

Present research carried out by the Midwest Consortium



Biofuels Overview

Michael Ladisch (Purdue University):

Introduction

Charlie Smith (CEO, Countrymark)

Biofuels: Challenges and Opportunities

Gene Petersen (Program Officer, US DOE Golden Field Office)

US DOE Office of Biomass Program

PURDUE UNIVERSITY

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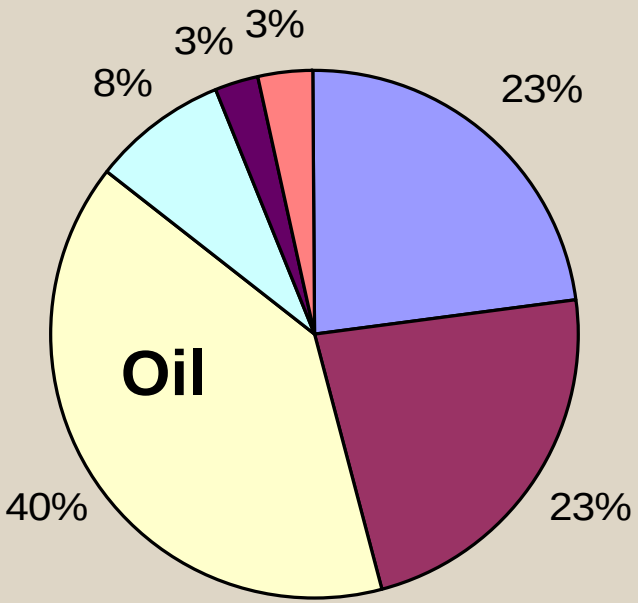
Introduction

U.S. Energy Consumption 2003



Tyner, 2005


Introduction

U.S. is the world's largest energy consumer (in total and per capita)

U.S. imports over 60% of our oil

40% of our energy consumption is oil

Ethanol = 2.5% of gasoline consumption

Tyner, 2005

Integral Part of US Energy Security

Ethanol from corn

- used in 12% of US gasoline
- accounts for about 2.5% of total gasoline (= 690 million Bushels Corn)

Soy diesel

- potential as an additive

Ethanol from corn and Biodiesel from soy have

- environmental benefits
- some impact on global warming
- may be higher cost than petroleum fuels

Costs

Dry Grind Ethanol Facilities

Currently grind corn and ferment to ethanol cost about $ 1.05 / gal capacity

(100 million gal per year)

Petroleum Refinery (rough ballpark estimate)

$2.5 billion / 150,000 barrels/ day

calculates to about $ 1 / gal capacity

2004 Ethanol Production Facilities

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Why Research on DDGS Utilization?

Establishment of dry-grind ethanol plants is growing rapidly in the U.S.

Currently, dry-grind ethanol plants produce 60% of fuel ethanol in U.S. By-products from dry-grind ethanol include wet and dry distiller's grains with solubles.

More than 7 million metric tons of DDGS is expected to be produced in the U.S. in 2005

By finding more products from DDGS, ethanol plants can improve their profitability and position themselves to etter withstand competition.

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Research and Future Directions

Discussions today will examine adding value to DG and DDGS through application of cellulose conversion technologies