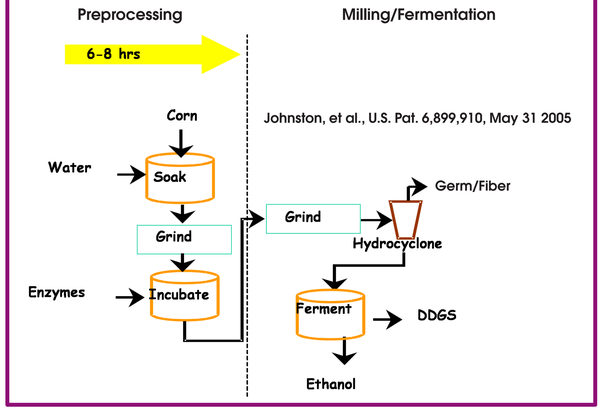
Bioethanol Research at the Eastern Regional Research Center, Wyndmoor, Pennsylvania

Food *AND* Fuels from Corn

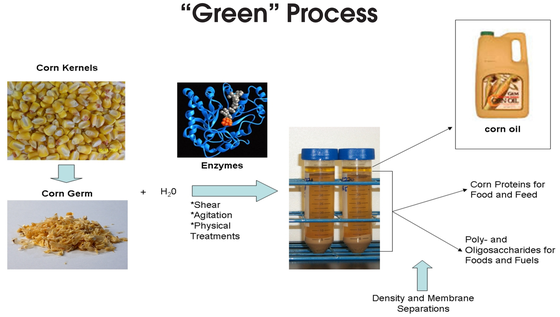
NEW PROCESSES

Using Enzymes to Optimize Ethanol Production and Maximize Coproduct Value



Johnston, et al., U.S. Pat. 6,899,910, May 31 2005

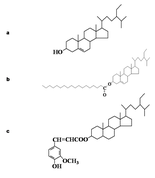
Using Enzymes to Produce Corn Oil, via a New Environmentally-Friendly "Green" Process



COPRODUCTS

"Amaizing Oil" - A Healthy Edible Oil

"Amaizing Oil" is extracted from corn fiber, a byproduct of corn wet milling.



Major health-promoting substances in "Amaizing Oil"

Samples available for testing!

- An **all natural, cholesterol-lowering edible oil** that contains three classes of phytosterols:
  - Free phytosterols (**a**) and phytosterol fatty acyl esters (**b**) which are recognized by the FDA for LDL-cholesterol-lowering ability.
  - Unique phytostanol and phytosterol ferulyl esters (**c**) that may combine antioxidant properties with cholesterol reduction.
- Obtained from corn fiber, a by-product of the production of ethanol and corn syrups
- Applications include:
  - Healthy, high-valued edible oil (similar market to olive oil)
  - Functional Food (Nutraceutical) Ingredient with cholesterol lowering and antioxidant properties
- The patent for Amaizing Oil (US #5,843,499) is owned by the **Agricultural Research Service (ARS), USDA and UMASS** and is **available for licensing**

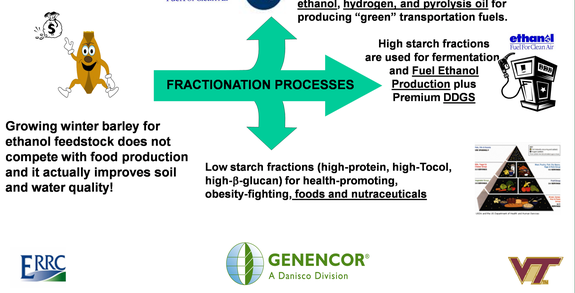
"Corn Fiber Gum" - A Potential Substitute for Imported Gum Arabic

"Corn Fiber Gum" is extracted from corn fiber, a byproduct of corn wet milling and fuel ethanol production.

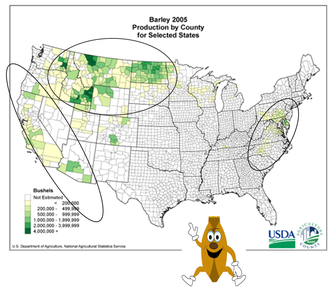
- **A natural polysaccharide made from the non-digestible portion of the corn kernel.**
- **Has high solubility in water.**
- **Adds no flavor or color to foods or beverages**
- **A powerful emulsifier for oils in water.**
- **Non-digestible**
- **Biodegradable**
- **Applications include:**
  - **"Home grown" substitute for imported gum arabic**
  - **Dietary fiber food ingredient**
  - **Potential prebiotic polysaccharide**
  - **Emulsifier for coatings and paints**
  - **Water based adhesives**
- The patent for Corn Fiber Gum (US #6,147,206) is **available for licensing**

Winter Barley – A Non-Food Crop for Ethanol Production that can Help Save the Bay!

Winter Barley, A Non-Food Crop that Can "Fuel" East Coast Ethanol Plants, Provide Income to Farmers, and Clean-up the Chesapeake Bay!



Barley is A Crop Grown Outside the Corn Belt



These "barley belts" can provide feedstock for ethanol plants outside the corn belt where transportation fuels and economic development are needed!

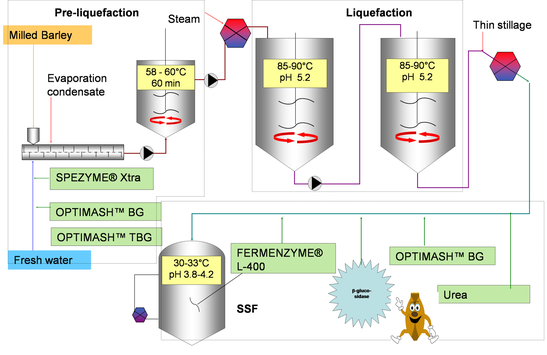
Why Winter Barley for Fuel Ethanol?

- Can grow in non-corn growing areas offering additional farm income where it is needed most to preserve farms and farmers.
- Provides feedstock for ethanol plants outside the Corn Belt
- Farmers on the East Coast and other areas with mild winters can grow barley as a winter crop, allowing double cropping with soy! This provides 3 crops (corn, winter barley and soy) in 2 years
- Winter barley acts as a cover crop, preventing soil and nutrient losses to the environment- this is critical for sustainability of soil and water. Especially important for the Delaware and Chesapeake Bays.
- Winter barley is grown on "fallow" land and does not compete with food crops.
- Barley DDGS have high protein and digestible amino acids
- Bottom Line: ~1-2 billion gallons of additional fuel ethanol could be produced from barley in the US while improving farm income and the environment.

ERRC/ARS Created Partnerships to Help Launch a Barley Ethanol Industry

- ERRC is working with breeders at Virginia Tech to develop better hull-less and hulled barley with high starch content for fuel ethanol production
- ERRC is developing dry fractionation and other processes to separate barley grain into fermentable and non-fermentable fractions and co-products
- ERRC is working with Genencor, A Danisco Division to use new enzymes to reduce viscosity, increase ethanol yield, and develop energy saving fuel ethanol processes
- ERRC is working with Osage Bioenergy who has plans to build 4 barley ethanol plants on the East Coast using the ERRC EDGE Process technology.

ERRC Researchers Working with Industry Have Created a New Barley "EDGE" Ethanol Process that Produces More Ethanol from Barley



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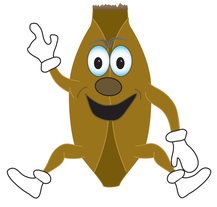

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