

## **Analytical Tools for Production of Non-Food Protein Corn**

*Submitted by Roger Ginder, Corinne Langinier, Darren Jarboe, & Lawrence Johnson, Iowa State University*

Ginder: ginder@iastate.edu  
Langinier: Langinie@iastate.edu  
Jarboe: jarboe@iastate.edu  
Johnson: ljohnson@iastate.edu

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**Progress report** (covers period of 10/1/2005-9/30/2007)

Specialty proteins production through plants presents Iowa an opportunity to impact the health and nutrition of millions of people. Successfully capturing this opportunity may stimulate much needed economic development in rural communities. Iowa's unique capability for production of these products was summarized in an overview of biosynthesis of specialty proteins by Dr. Julio Baez, Senior Research Fellow, Fibrogen, Inc. at the April 22, 2004 BIGMAP Risk Assessment Symposium. Examples of specialty proteins he outlined are antibodies, vaccines, hormones, and enzymes. This project will evaluate the market and business impacts of pretreatment system adoption for non-food proteins (i.e. pharmaceuticals, industrial proteins) located in the germ and endosperm. Analytical tools will be developed to identify the financial implications of implementing a degerming process that captures non-food proteins and the potential impact on an ethanol facility. The tools will assist with two key factors in the value chain, the range of premiums acceptable to producers to grow the non-food protein corn products and the range of price levels that support production to meet regulatory requirements.

### Objectives

1. Identify the marketable products from a non-food protein corn product located in the germ and estimate a range of potential returns for the products in the value chain.
2. Identify the marketable products from a non-food protein corn product located in the endosperm and estimate a range of potential returns for the products in the value chain.
3. Identify and evaluate the economic benefits of degerming kernels for non-food protein extraction prior to the dry grind ethanol process at various corn and ethanol price levels.
4. Evaluate feasible premium levels for the non-food protein corn product value chains identified in objectives 1 and 2.
5. Evaluate the economic benefit to producers of the non-food grade protein corn products at feasible premium and yield levels.

## Deliverables

1. Provide a working paper that describes and evaluates the value chain for non-food protein corn products located in the germ.
2. Provide a working paper that describes and evaluates the value chain for non-food protein corn products located in the endosperm.
3. Develop analytical data and tools to assist in evaluating the financial viability of using dry milling as part of the non-food protein corn processing value chain.

## Project Activities

We have a prototype model with four different scenarios:

1. traditional ethanol plant, dry grind process;
2. dry grind process with oil extraction form DDGS;
3. specialty protein process;
4. degerm process: an application to gelatin.

We are looking at the cost benefit analysis of each of these scenarios. The first is completed, whereas the last three need to be completed with information about the cost of new materials and the benefits of the added protein extracted.

Project investigators have visited a few plants. Ginder and Langinier met with Brad Davis, Corn, LP in Goldfield, Iowa. They also met with Larson Dunn, Lincolnway Energy, LLC in Nevada, Iowa. Dunn previously worked for Archer Daniels Midland at a dry grind facility that fractionated the kernel as part of its process. Ginder met with Jim Leiting, General Manager, Big River Resources LLC (BRR), an ethanol plant in West Burlington, Iowa that had fractionation capabilities in the plant's original design. BRR had engineering studies completed for the entire plant, including the fractionation facility. Due to the significant upfront capital costs and excellent margins on ethanol, BRR decided to build an additional ethanol plant rather than invest in fractionation.

Jarboe met with Dan Hammes, QTI, Inc. at the Corn Utilization and Technology Conference where he was presenting information about Solaris products that increase the total value of ethanol co-products. Solaris products are created by fractionating the corn kernel prior to the ethanol production process. Hammes presented how ethanol plants can incorporate the fractionation technology into new plant design or retrofitting a current plant. QTI installed a fractionation system at Badger State Ethanol, LLC, a dry-mill ethanol production facility in Monroe, Wisconsin that started production in mid- October, 2002. Ginder has spoken to Hammes about acquiring data that could be aggregated with the data from other entities to develop an economic model. QTI has been unable to supply the data.

Data have been collected on the costs and benefits of traditional ethanol plants, specialty protein corn production and degerming processes (e.g., quick germ). Langinier met with Vijay Singh, University of Illinois when he visited Iowa State on October 16, 2006 and gained more information about the quick germ process. The patented process was developed by Singh and his

colleagues. Singh and his team’s publications have provided enough data to model systems that use the “quick germ process.” Modeling the data is underway.

Iowa State has been unable to acquire the data necessary to create the fractionation economic model for the other processes. First, intellectual property rights exist on some of the processes, and therefore the few plants using the process would have to pay royalties. Second, even if some plants are planning to introduce kernel fractionation into their ethanol production process, they do not share the information they have.

The next step is a less desirable alternative, which is to have an engineering study completed for a model fractionation facility. The study will enable us to get preliminary numbers to show plant managers, allowing them to react to value ranges provided rather than give us proprietary data. These reactions will be aggregated to develop a robust economic model for kernel fractionation at a dry grind ethanol facility.

Report and Journal Article

A 30-page report has been developed. It is missing the fractionation data as mentioned previously.

Langinier is working on a theoretical paper that may be submitted to a special ethanol edition of the Journal of Agricultural and Food Industrial Organization in 2007

Additional Support

The project has been expanded through support from other sources. The Iowa Corn Promotion Board provided \$25,000 and the Iowa Grain Quality Initiative \$15,000 for food grade protein applications. Iowa State University has provided indirect cost support (47%) for the project and the project expansions.

<b>Summary of Meetings for Roger Ginder, Corinne Langinier, and/or Darren Jarboe</b>					
<b>Meeting/Workshop Title</b>	<b>Date(s)</b>	<b>Location</b>	<b>Approximate Attendance No.</b>	<b>Type</b>	<b>Purpose/Topic Presentations</b>
Iowa Corn Promotion Board Meeting	3/24/04	Ames, IA	50	Iowa Corn Promotion Board Staff	Discuss research priorities for ICPB
Iowa Corn Promotion Board	7/9/04	Johnston, IA	3	ICPB Staff, Ginder & Jarboe	Corn degerming for producer-owned ethanol plants
Iowa Corn Growers Assn./Iowa Corn Promotion Board Biotechnology Comm.	8/5/04	Johnston, IA	18	ICPB Producers & Staff, Ginder & Jarboe	Project on corn degerming for producer-owned ethanol plants
Specialty Corn Processing Model Development	10/8/04	Ames, IA	4	ISU Faculty & Staff	Plan the specialty corn processing project.

Corn Degerming Project	1/24/05	Ames, IA	4	ISU Faculty & Staff, Fibrogen, Inc.	Corn degerming project update
Iowa Corn Growers Association & Promotion Board Biotechnology Comm.	2/17/05	Johnston, IA	10	Corn Producers	Corn degerming project progress report
<b>Summary of Meetings for Roger Ginder, Corinne Langinier, and/or Darren Jarboe</b>					
<b>Meeting/Workshop Title</b>	<b>Date(s)</b>	<b>Location</b>	<b>Approximate Attendance No.</b>	<b>Type</b>	<b>Purpose/Topic Presentations</b>
Steve Eckhoff, Ag. Engineer, Univ. of Illinois	3/08/05	Champaign, IL	2	Eckhoff & Ginder	Discuss corn degerming project and plan future work
Corn Degerming Project	4/27/05	Ames, IA	4	ISU Faculty & Staff, Fibrogen	Corn degerming project update
Gold Eagle Cooperative	6/21/05	Goldfield, IA	5	General Manager and ISU Faculty	Corn pretreatment for ethanol facilities project
Corn Degerming Project	6/28/05	Ames, IA	4	ISU Faculty & Staff, Fibrogen	Corn degerming project update
Corn Degerming Project	7/19/05	Ames, IA	4	ISU Faculty & Staff, Fibrogen	Corn degerming project update
Corn Degerming Project	11/1/05	Ames, IA	4	ISU Faculty & Staff	Corn degerming project update
Dan Hammes, President, QTI, Inc.	6/5-7/06	Dallas, TX	500	Hammes & Jarboe	Met with Hammes at the Corn Util. and Tech. Conference
Lincolnway Energy, LLC (LE)	8/17/06	Nevada, IA	5	LE Staff & ISU Faculty	Corn processing systems
Vijay Singh, Ag. Engineer, Univ. of Illinois	10/16/06	Ames, IA	2	Singh & Langinier	Discuss the quick germ process
Pine Lake Corn Processors	10/17/06	Steamboat Rock, IA	3	Scott Zabler, Ginder & Langinier	Discuss front-end corn degerming system
Iowa Grain Quality Initiative Advisory Committee	1/12/07	Ames, IA	20	Iowa Commodity Groups, Government, ISU Faculty & Staff	Update and discuss the corn degerming model project