Center for Crops Utilization Research

Winter 2001

ISU Grain Quality Initiative

The Iowa Grain Quality Initiative (IGQI) is an interdisciplinary research and information program led by Dr. Charles Hurburgh (ABE). The IGQI’s mission is to “increase economic returns to Iowa Agriculture by maintaining a process for developing and implementing a strategic vision for Iowa grain producers.”

This effort focuses on marketing GMO grain, NIR detection of GMO grain, corn trait ID studies, developing producer alliances, development of contracting software, using cooperatives to add value to corn growing operations, development of an ISO9000 registration methodology for grain handling, and studies on the agronomic and environmental impacts on grain quality.

IGQI Program Coordinator Darren Jarboe reports that two recent genetically modified (GM/GMO) grain issues workshops held in the Scheman Continuing Education Building, Iowa State Center, adjacent to the ISU campus, were very well received. The first, September 15, 1999, had 500 participants. The most recent, February 24, 2001, had 220 participants. Contact Darren Jarboe at (515) 294-3137, or visit their link via the CCUR webpage.

Exotic Corn Germplasm and Novel New Corn Oils

Dr. Pam White (FSHN), Dr. Linda Pollak (USDA-ARS, Agronomy), and Research Scientist Sue Duvick (USDA-ARS) are surveying Latin American corn lines for germplasm with potential food and non-food applications and having unique functional properties. Recent work has identified corn lines of considerable value to increasing the genetic diversity of commercial varieties. Currently, their research is focusing on the ability of crosses with agronomic lines to maintain the traits over several generations, as well as look at long-term gene interactions within these new crosses.

Additional work, pioneered by Sue Duvick, is looking at corn and trypsicum crosses for unique oil traits. *Trypsicum* is a close relative of corn and, along with teosinte and a wild maize relative, are what many researchers believe to be the early components of what became modern maize. Duvick’s research has identified crosses that can result in new oils with extremely novel fatty acid compositions. A patent was recently filed to protect the intellectual property.

For more information, consult the Center for Crops Utilization Research web page at www.ag.iastate.edu/centers/ccur
Modified Oils and Oil Blends

Fats and Oils Chemist, Dr. Earl Hammond (FSHN), is conducting research on several soy oil antioxidants that has resulted in one highly promising compound, not suited to food applications, but ideal for non-food applications. This material has lubricity properties that make it particularly suitable as a high-value additive in lubricants for engines and high-speed components. This research has resulted in a patent application.

Additionally, he is investigating modified soybean oil blends for use as a castor oil substitute. Currently, castor oil is used in some vegetable-oil-based lubricant blends due to its 80% hydroxy-fatty acid composition. As more industrial lubricating oil blends are derived from soybean or other vegetable oils, the price of castor oil (an oil usually in very low supply) could alarmingly increase. For this reason Hammond and his students are investigating substitutes from modified soybean oils. The work involves the use of light and photo synthesizing compounds (e.g., chlorophyll, rose bengal) to oxidize some of the soy oil to hydroperoxides, then reducing these to get the proper hydroxy fatty acid mixture. The research has been very successful, but the additional work to make the processes cost effective is in its infancy. At this time, the photo synthesizing compounds are too expensive for commercial production systems.

Hammond, one of the world’s foremost cheese flavor and milk-fat researchers, is leading other students on a quest to understand how a mixture of short-chain fatty acids from milk fat can be incorporated into soy protein, or how the fatty acids can be produced within modified soy oil to make an all soy, low fat, low cholesterol cheese product. Such a product would be a dietary dairy substitute with the anti-cancer antioxidant benefit of a soy product. So far they have developed a promising blend of milk fat and soy protein, fermented with Italian- and Swiss-cheese microorganisms.
Soy Adhesives and New Fiber Sources

Deland Myers and Monlin Kuo are key members of what is now known as the Biocomposites Research Group. This research group is looking at agriculturally derived adhesives and underutilized fiber sources. Their efforts have resulted in several new technologies undergoing patent protection, and have progressed to technology transfer initiatives that involve several private partners.

One area of research is a “totally green” fully biodegradable, completely non-toxic, environmentally sound soy adhesive. This material is 100% soy protein. Current formulations have the water-resistance and tensile strength of currently used “interior-grade” urea-formaldehyde wood adhesives. This adhesive is perfectly suited to countertops, laminated paneling and similar applications.

A second area of research involves soy adhesive blends that utilize conventional wood adhesives for use in specific products and joinery systems. One specific application is in end-jointed lumber. This procedure is certified by the Western Wood Products Association, and utilizes scraps and small pieces of wood that otherwise would be burned for fuel, or chipped and used in chip board. These wood products are extremely strong and very dimensionally stable, however, they do use a great deal of adhesive. The new adhesive technologies developed by the Biocomposites Research Group are cost-effective alternatives to conventional adhesives, improving an already economical technology.

Adhesives are one of five areas targeted by the soybean check-off to develop new uses for soybeans. The check-off’s goal is to further develop the soy-based adhesives market from the current 2 million bushels a year to 23 million bushels a year by 2005.

Instrumental contributors to this milestone achievement are Deland Myers (FSHN) and Monlin Kuo (Forestry), their students, staff, and the other members of the Biocomposites Research Group. They have developed a soy-based wood adhesive that has won the approval of the Western Wood Products Association for vertical and horizontal use in finger-jointed lumber. Previously, the soy adhesive product had been approved only for vertical use. Soybean check-off investments helped develop the soy-based wood adhesive, which now can be used for a wide variety of products, such as windows, fences, and I-joists. One of the many environmental benefits of this technology is reduced emissions of volatile organic compounds in the home and wood product manufacturing environments.

The third area of research looks at increasing biomass utilization by focusing on underutilized fiber sources bound with soy adhesive or soy-adhesive and conventional synthetic resin blends. These fiber-adhesive systems are relatively application specific, and exhibit great promise for commercial products that range from relatively low-value products like reinforced packaging materials, through various construction and insulation materials, to high-value products like molded furniture carcasses and similar products. Related research is looking into how various fibers can be used as components in fiber-plastic materials. Fiber sources include switch grass, recycled wood, cornstalk, wheat straw, manure (animal-processed fiber or APF), and industrial waste streams.

For more information, contact
the Center for Crops Utilization Research
Iowa State University (515) 294-0160

Dr. Monlin Kuo inspects a sample chair seat while Yilin Bian removes a sample from a compression-molding machine in one of CCUR’s pilot plants.
Stockholm Address

Lawrence Johnson recently traveled to Stockholm, Sweden, to attend the annual meeting and induction ceremony of the Royal Swedish Academy for Agriculture and Forestry. Dr. Johnson was inducted in 1999 as a foreign member of this prestigious body and was asked to deliver a talk with Dr. Peter J. Johnsen, USDA, NCAUR, Peoria, IL, this year’s inductee.

Peter Johnsen and Lawrence Johnson were asked to present a talk based on their contributions to the US Department of Energy study, published in 1999, titled “The Technology Roadmap for Plant/Crop Based Renewable Resources 2020.” Additionally, they were asked to give their opinions on the agricultural policy of the new US Administration. Dr. Johnson and Dr. Johnson spoke on current and anticipated trends in American biorenewable research. They were invited by Bruno Nilsson, Secretary General and Managing Director, Royal Swedish Academy for Agriculture and Forestry; and were hosted by Ragnar Ohlson, Professor (Ret.) Lund University Environmental Scientific Network.

The Academy reception and dinner at the Musikaliska Akademien were attended by Princess Christina and other Academy dignitaries.

Additionally, Lawrence Johnson discussed current issues in agricultural sciences with Lennart Prage, Director, and Ann-Cristin Bylund, Rector, Swedish University of Agricultural Sciences (SUAS), Uppsala; Christoffer Rinman, Executive Assistant, Federation of Swedish Farmers Union; Gustav Brunius, Associate Professor, The Swedish Gene Technology Advisory Board, Solna; Karl Erik Olson, Swedish Member of the European Union Parliament, Sosdala; as well as discussed potential student exchanges between ISU and SUAS.

For more information, contact the Center for Crops Utilization Research Iowa State University (515) 294-0160
**Mexican Consulting Trip**

Larry Johnson, CCUR, FSHN, Collegio de Postgraduados, Puebla, Mexico, from December 4 to 10, 2000, at the request of Collegio’s President Benjamin Figuerero. Collegio de Postgraduados is an agricultural graduate studies university. Dr. Johnson presented an overview of CCUR and led a workshop on preparing a proposal to develop a research center (somewhat along the lines of CCUR) to target adding value to the crops produced by farmers farming 5 hectares or less. Other discussion involved exploring various collaborative proposals.

Additionally, Dr. Johnson travelled to Chapingo University (agricultural undergraduate studies) and CYMMT (Centro Internacional para Mejoramiento del Maíz y Trigo, aka Centro Internacional para Mejoramiento del Maíz y Trigo (the International Maize and Wheat Improvement Center) to tour their facilities and explore possible collaborations.

**Starlink Corn**

Dr. Charles Hurburgh (ABE) and Darren Jarboe, Iowa Grain Quality Initiative (IGQI), have been busy handling questions related to the Starlink™ corn testing and related Genetically Modified grain (GM and GMO) issues.

In September 2000, trace amounts of Cry9C protein from Aventis Bt corn (marketed as Starlink™) were found in taco shells manufactured by Kraft Foods and distributed through the Taco Bell fast food chain. Starlink™ was not approved in the US for human consumption by FDA, but had been approved for animal consumption and industrial uses. The discovery of Cry9C in taco shells and the subsequent product recall defined the challenge to the US grain production, marketing, and processing industries.

Steps have been taken by Aventis to compensate producers and grain handlers for economic losses they might incur by commingling Starlink™ with other corn. Immunoassay test kits have provided a quick method to detect the presence of Starlink™ in inbound loads of corn. Starlink will not be sold as seed corn this year, thus preventing more Starlink™ corn in the system. It is estimated that Starlink™ corn from the 2000 crop will be in the system for 2-4 years.

More work has been done since September 2000 to determine what harm might occur if Cry9C protein inadvertently finds its way into food products, and how US government agencies can better regulate the introduction of biotech products. Cry9C protein is a unique Bt protein not found in other Bt corn varieties. Like other Bt proteins, it provides resistance to the European Corn Borer (ECB), but it more closely resembles plant proteins that are known allergens. Because it digests slowly in humans, its potential allergenicity may be increased. To date, thirty-four complaints have been filed by individuals claiming that they have experienced allergic reactions after consuming milled corn products.

The Environmental Protection Agency (EPA) convened a Scientific Advisory Panel in late November 2000 to determine if Cry9C was likely to be an allergen and what possible level of exposure might produce allergic reactions in humans. Charles Hurburgh, Agricultural and Biosystems Engineering, ISU, and Dirk Maier, Agricultural Engineering, Purdue University, were invited as experts on grain production, quality, and handling. They joined several medical experts to study these issues and make a recommendation to EPA on how the corn already in the system might be better regulated. The panel was unable to make a recommendation for a tolerance level for Starlink™ in grain corn due to the inconclusive nature of the allergy studies. On May 2, 2001, the panel will reconvene to hear FDA’s report on its follow-up of individual claims of allergic reaction. Members of the Iowa Grain Quality Initiative have provided a complete summary and timely updates on this situation on the Internet at www.iowagrain.org.
International Travel and Presentations

July 12-13, 2000, Dr. Lester Wilson (FSHN) presented Effects of Processing on the Flavor of Soybeans and Soy Products, at the seminar “Soybean: Excellence in Taste, Nutrition and Quality,” at the U.S. Trade Center in Mexico City, Mexico.

Dr. Wilson presented the “Iowa Perspective,” what producers and processors need to know when developing new soy products of national and domestic markets. This talk is a result of Dr. Wilson’s outstanding outreach efforts to Iowa soy processors and market research into Asian soy food products and marketing systems.

Dr. Pam White (FSHN) and Dr. Earl Hammond (FSHN) travelled to Kyoto, Japan, October 22-27, 2000. They chaired sessions and presented papers at the Oil Chemists World Congress, a joint meeting of the Japanese Oil Chemist’s Society and the American Oil Chemists Society.

Biodegradable Plastics Research Licensed

Dr. Jay-lin Jane (FSHN) and her research team are world leaders in the development of soy-protein-based biodegradable plastics. They have developed protocols for processing protein isolates, concentrates and flours, using conventional processing methodologies that include extrusion and compression and injection molding. Current research is directed toward increasing the shelf-life of the soy protein plastics by including additives that reduce the plastic’s attractiveness to atmospheric moisture.

Iowa State University recently granted an exclusive Right of Commercialization License, concerning the patented research of Dr. Jane, to Soy Works, Goodrich, Illinois, to market and promote this technology.

Patent to Process Genetically Modified Soybeans Licensed

A soybean processing patent, Process for Producing Improved Soy Protein Concentrate from Genetically-Modified Soybeans, U. S. Patent 5,936,069, recently was awarded to Dr. Lawrence Johnson (FSHN). This research involves an economical method for production of soy concentrate from soybeans modified to reduce or eliminate raffinose, stachyose, and lipoxygenase content and the off-flavors associated with these compounds. The lower processing costs associated with this technology offers a superior alternative for many processors. Recently, Iowa State University licensed the patent to Protein Technologies Corporation. Protein Technologies Corporation is a joint venture of DuPont and Pioneer Hi-Bred Int., Inc.

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Crop Products Pilot Plant
http://www.ag.iastate.edu/centers/ccur/cropprodpiilotplant.html

Biocomposites Research Group
http://www.public.iastate.edu/%7Ebiocom

ISU College of Agriculture
www.ag.iastate.edu

NASA Food
http://www.ag.iastate.edu/centers/ftcsc

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