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AG INNOVATION NEWS®

The newspaper of the Agricultural Utilization Research Institute

Waste not

Stalks, hulls, even grass seed chaff are no longer considered waste ... a special look at ag coproducts

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PHOTO BY ROLF HAGBERG

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Transfats on the label

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CORN - SOYBEANS - FIBERS - LIVESTOCK

Using it all

Once considered leftovers, agricultural byproducts can be valuable assets

BY E.M. MORRISON

Corn stalks, distiller's grains, oat hulls, bean straw, offal, manure, seed chaff …

They are not waste products anymore. And don't just call them byproducts. The new industry term is "coproducts" — refuse turned into an amazing variety of valuable commercial goods.

There is strong interest in finding uses for what was once considered worthless agricultural waste, says Al Doering, manager of AURI's coproducts lab in Waseca. Growers, commodity groups, entrepreneurs and manufacturers have come to see the off-shoots of ag production and processing as desirable raw materials with profit potential, he says.

Emerging uses for crop residues, animal waste and other materials include biofuels, feeds and polymers, Doering says. AURI is a state leader in coproduct development, focusing especially on processing and handling challenges. "There are very few facilities like ours around the country, where entrepreneurs can do pelleting and other experimental work on coproducts," Doering says.

Here's a quick look at some of Minnesota's "wasteful" ag coproducts and what they are being used for.

Sources:

Agricultural Utilization Research Institute
American Coalition for Ethanol
Minnesota Agricultural Statistics Department
Minnesota Agri-Growth Council
Minnesota Department of Agriculture
Minnesota Farm and Food Coalition
National Biodiesel Board
University of Minnesota

PHOTOS BY ROLF HAGBERG

More than waste

BY EDGAR OLSON
AURI EXECUTIVE DIRECTOR

The phrase 'the whole is greater than the sum of its parts' is not necessarily true of agricultural products.

Corn isn't just corn. Soybeans aren't just soybeans. Wheat isn't just wheat. All these commodities contain smaller components — oil, starch, germ — that may have as much value as the whole grain, sometimes more. And there is value in the leftovers of processing these ag products.

For ethanol production, the desired corn component is starch, which is converted to sugar, then fermented to produce grain alcohol. The leftovers, dried distiller's grains, are not just waste but another product that can be used to increase corn's overall value. DDGs can be used in swine, poultry and cattle rations or even as a biomass energy source.

In biodiesel refining, soybean oil goes through a transesterification process that yields soy methyl esters, otherwise known as biodiesel. A byproduct of biodiesel production is glycerin. Already used in hundreds of applications like soap and toothpaste, glycerin is a valuable coproduct that is receiving lots of attention now that Minnesota's biodiesel industry is taking off.

Every product and coproduct has value. Our goal at AURI is to provide the assistance necessary to help each Minnesota commodity reach its highest and best use — to get the most value out of each and every component.

This issue of Ag Innovation News includes a special feature on coproducts, an area AURI has focused on for many years. We recognize that developing innovative uses for what once was considered waste is key to increasing a commodity's overall worth.

Sometimes the sum of the parts is greater than the whole. ■

Editor's note: *After guiding AURI as executive director for more than eight years, Edgar Olson has announced his intentions to retire in early 2006. More information on his retirement and a possible successor will appear in the next issue of Ag Innovation News.*

Waste not: CORN

BY E.M. MORRISON

Minnesota is a "corny" state — growing about one billion bushels of the grains every year. Almost half of Minnesota's corn crop is exported, and another 20 percent feeds the state's livestock. About 15 percent of the corn crop is refined into hundreds of different industrial and consumer products, including food, cosmetics, solvents, textiles, cleaning products and plastics. An equal amount is made into ethanol.

Ethanol

Minnesota now produces about 550 million gallons of ethanol a year. The transportation fuel consumes one-sixth of the state's corn crop, and that could rise to one-quarter by 2010. Today nearly all gasoline sold in Minnesota is blended with ethanol.

DDGS
A 56-pound bushel of corn produces about 2.7 gallons of ethanol and 17 pounds of distiller's dried grains with solubles, or DDGS. Minnesota produces more than one million tons a year.

Cow chow
DDGS used to be a low-quality product, without much value. But Minnesota's "new generation" ethanol plants make high-quality DDGS that are in demand to feed cattle, dairy cows, swine, poultry — even fish. But that's not all this coproduct is being used for.

Good licks
A Morris ethanol plant is pressing DDGS into protein lick blocks to supplement forage diets for cattle, horses, elk and dry cows.

Piggy provender
Corn solids, called solubles, remain in the ethanol processing water. These solubles can be dried and used to fortify baby pig feed.

Nutrition bits
DDGS can be broken out into components such as amino acids, proteins and specialty sugars, for use in medicines and foods, including low-cal sweeteners, nutritional drinks and weight loss products.

Packing heat
DDGS can be pressed into fuel pellets and burned in pellet stoves or gasified.

Tiny bubbles
Ethanol processing generates carbon dioxide, which is used to carbonate beverages, make dry ice, and flash freeze meat.

High spirits
High-grade ethanol is used in beverages, such as Shakers Original American Vodka, made by Chippewa Valley Ethanol Company in Benson. High-grade ethanol is also used in solvents, cleaning products, cosmetics and medicines.

Corn stover

It's known as corn trash — the stalks, leaves, husks and cobs that ordinarily end up back on the field after combining — but don't call it garbage. One researcher likens corn stover to "a barrel of crude oil." U.S. farmers produce three tons of stover per acre of corn, and this abundance has sparked many creative efforts to find profitable uses.

Heating fuel
Shelled corn has long been used in home heating stoves. Corn stover also makes a good heating fuel. The University of Minnesota Morris plans to gasify corn stover to heat and cool the college campus. Corn stover is also being turned into pellet fuel for home pellet stoves. Someday, corn stover energy could be used to generate hydrogen for fuel cells.

Fertilizer
Corn stover's potassium and phosphorous remain after burning and can be used as fertilizer.

Comfy cushions
Corn stalks make comfortable cattle feedlot bedding. In compost dairy barns, corn cobs are a soft substitute for wood-chips.

Resting rugs
Rigid, disposable corn-stalk mats for hog nurseries and farrowing crates are a renewable alternative to rubber mats, which have to be disinfected between uses.

Mulch mats
Fiber mats for soil erosion-control, mulching and seeding are being made from corn stover and other crop residues.

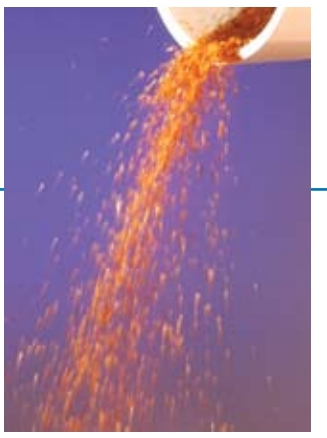
Spill soakers
Corn stover is useful for soaking up liquids in absorbent products such as oil filters and oil-absorbent blankets and mats.

Paper pulp
Corn stover and other ag fibers, such as beet pulp, wheat straw and barley straw are replacing wood pulp in paper, oriented strand board, and composite building materials.

Renewable polymers
Corn stover and many other kinds of ag fibers can be refined for biodegradable polymers, which are used in plastics, packaging films, foams, adhesives and many other manufactured goods. The processing has not yet been commercialized, but scientists like the University of Minnesota's Roger Ruan say it's just a matter of time.

Tomorrow's hydrocarbons
Today, Minnesota's ethanol plants use just the corn kernel to make alcohol, but it's also possible to make ethanol from crop residues, like corn stover.

Waste not: CORN



Easing the sidestream flow

AURI and corn growers sponsor nation's first study to improve handling of ethanol coproduct

BY DAN LEMKE

Waseca, MN — Ethanol is a triumph for Minnesota agriculture. The state's annual production — 500 million gallons last year — was only 11 million gallons 15 years ago. And it's likely to surge again in 2013 when a state provision could require a 20-percent ethanol blend in all gasoline sold here.

But in the wake of ethanol's free-flowing fuel production, there are sidestreams that need to keep pace with the industry.

Distiller's grain, an ethanol coproduct, is typically coated with another coproduct: syrup. Then it is dried to yield DDGS or distiller's dried grains with solubles. The Minnesota Corn Growers Association estimates the state already produces 1.4 million tons of DDGS per year, and more plants are being built.

Most of these DDGS are sold for poultry, swine and cattle feed, but supply exceeds the state's demand, so the overflow is often shipped to global markets. However, long distances and moisture can cause the DDGS to become compacted and sticky, making it difficult to unload.

Alan Doering of AURI's coproduct utilization lab in Waseca says some DDGS shipments have been discounted by thousands of dollars because of poor flow and the cost of extra labor and time to unload ships, train cars and trucks.

So AURI and the Minnesota Corn Growers initiated a study to see what conditions hamper DDGS flow and what may be done to improve it.

Many of the corn association members and leaders "are also investors in these ethanol plants" and aware of the flowability problems, says Yvonne Simon, a Minnesota Corn Growers staff person.

About 5,000 producers own shares in Minnesota's 14 ethanol plants, which use 16 percent of the state's corn crop, according to the Minnesota Department of Agriculture. Moreover, the industry leverages 5,000-plus jobs and $1.3 billion in economic activity.

"This is an issue that affects every ethanol plant in Minnesota," Doering says. "It can impact their profitability, which means it affects the bottom line of the producers who have invested in them."

The MCGA and AURI enlisted Jenike & Johanson, a bulk solids design and engineering firm from Massachusetts, to to evaluate various DDGS traits. The firm analyzed distiller's grains flow characteristics, compared different grain hopper designs and outlet sizes, and tested the effect of pelleting grains.

Five DDGS samples were tested: two controls and three modified samples, including de-oiled DDGS, a reduced-syrup sample and pelletized DDGS.

The study, completed in October, revealed that "particle size and relative humidity played the biggest roles in flowability," Doering says. "We expected that the de-oiled DDGS and the pelleted distiller's would flow best, but that wasn't always the case."

The study showed that larger particles flowed best, regardless of oil or syrup content. The larger particles even flowed better than the pelleted sample, which showed minimal improvement.

Humidity had little impact until it rose above 60 percent — at that point distiller's grains quickly absorb moisture, which can reduce flowability. Particles also tend to expand as they warm, which can reduce flowability.

The study was the first of its kind in the country and has drawn attention from around the nation. "We don't have all the answers yet, but what we do know about distiller's grains now can impact not only ethanol plants but feed managers and even our own product development," Doering says. "We've answered a lot of questions, but created a few more, too."

"We have some information that is leading edge," says Simon. "Now that we know how DDGS are affected by things like heat and humidity, we need to figure out how we can keep the distiller's stable, so once it reaches markets like China, Japan or Spain, it flows and has good nutrition value." ■

The flowability report summary is available on AURI's Web site: www.auri.org. Click on the research button and highlight "flowability report."

Energizing ethanol

Minnesota plants find ways to save energy while making it

BY DAN LEMKE

Owatonna, MN — It takes energy to make energy. The electricity and fossil fuels needed to convert corn to ethanol can cost millions, depending on a plant's size.

That's why some Minnesota ethanol plants are using innovative technologies such as burning wood biomass or a syrup coproduct to lower energy costs.

Wood waste fuel

Central Minnesota Ethanol Cooperative in Little Falls, Minn. broke ground this fall on an $8 million on-site biomass plant. A gasifier will convert wood waste and other biomass to electricity. When the facility begins operating later this year, it will be the first of its kind in the country.

CMEC General Manager Kerry Nixon says the gasifier should reduce emissions, lower production costs and protect CMEC shareholders' investment.

"We've created a market for an otherwise wasted product," Nixon says. "It's also creating jobs and that's what it's all about." Wood waste is the primary fuel source, but Nixon says dried distiller's grains left over from making ethanol are a secondary source.

CMEC has received a $2 million USDA grant and another $2 million from Xcel Energy to help construct the gasifier.

Burning syrup

Corn Plus in Winnebago, Minn. is reaping the rewards of another innovation. It is the first ethanol plant in the country to use fluid-bed technology to burn syrup, an ethanol coproduct, for energy.

General Manager Keith Kor says the syrup is normally sprayed back onto distiller's grains and sold as feed. But there is more value in burning the syrup as it significantly reduces the plant's natural gas consumption. Corn Plus produces 44-million gallons of ethanol per year.

"We've been at full production since September 1," Kor says. "In the month of October, we were able to reduce our natural gas consumption by about 50 percent. We're excited about that, but we think we can reduce it even more."

The fluid bed uses air and heated sand to generate steam. It also produces ash that Kor says has value as fertilizer.

"A lot of people are looking at using various techologies to generate heat or electricity," says AURI's Alan Doering. "Ethanol plants use a lot of energy, but by using their own coproducts, they can cut down on a lot of the outside fuels they need to buy. Saving money is as valuable as making money." ■

PHOTOS BY ROLF HAGBERG

Waste not:
ANIMAL COPRODUCTS

Minnesota ranks among the top ten states in nearly every livestock production sector, including red meat production (4th), hogs (3rd), milk (6th), chickens (10th), and turkeys (1st). Animal agriculture contributes $10 billion to Minnesota's economy, including more than $4 billion in annual farmgate sales and more than $5 billion in added value.

Manure

Fab fertilizer
Livestock manure returns plant nutrients and organic matter to the soil, completing the nutrient cycle and creating a self-sustaining agricultural system. But these days, manure isn't just for fertilizer.

Powerful dung
Manure makes good fuel. A Benson, Minn., company is building a power plant that will generate 50 megawatts of renewable energy from turkey litter, beginning in 2007. The power plant will use 500,000 tons of turkey manure a year.

Gas to electricity
Methane generated from dairy manure through anaerobic digestion is being used on large Midwest livestock farms to make electricity. Methane can also be collected from municipal solid waste and food processing sludge. And at least two Minnesota cities are interested in producing biogas from manure or food waste.

Animal processing remains

Composted critters
Composted livestock makes great fertilizer and soil amendments. A St. Cloud, Minn., company makes humus, potting soil and other garden products from composted poultry processing waste and yard waste. An Alexandria, Minn., company is making phosphorus-free turf grass fertilizer from liquefied fish and distillers grains. A commercial tilapia farm in Renville, Minn., composts dead fish for fertilizer.

Offal-ly powerful
About 60 percent of a live animal's weight is meat cuts. Everything else — skin, bones, fat, organs, blood, trimmings — is coproduct used by rendering companies, pet food manufacturers and the leather industry. Rendered animal fat can also be used to make biodiesel fuel. AURI has helped small meat processors market their coproducts collectively, so nothing is wasted.

Greasy fuel
Recycled yellow and white greases, beef tallow and chicken fat can be burned for boiler fuel or processed for biodiesel.

Garden wool
Short wool fibers trimmed from blankets are being used to make landscaping fabric for commercial strawberry growers.

Fluff food
Feathers, a byproduct of livestock rendering, are powdered for livestock feed.

Dairy

Whey more than waste
Whey, a watery leftover from cheese making, used to be treated as sewage. Now, it's being made into protein concentrate and added to bakery products, infant formulas, candy and energy bars. In the future, whey may be used for oxygen-barrier coatings on food and plastics, and even to make ethanol.

Waste not: FIBERS

Fiber, fiber, everywhere: Alfalfa stems, aspen, corn stover, culled dry beans, DDGS, grass seed chaff, hazelnuts, oat hulls, peat, poplars, red-top grass, reed canary grass, rye-grass straw, soybean hulls, soybean straw, sugar beet pulp, sunflower hulls, timothy-grass straw, wheat straw, wild rice hulls, willows … the list goes on. Plant fiber — the same organic matter that eons ago became crude oil — offers immense potential for fuels and industrial products.

PHOTOS BY ROLF HAGBERG

The seed chaff from Kentucky bluegrass, above, and ryegrass, pictured on the cover, have been test-burned in a gasifier as a potential fuel source for electrical generation.

Biomass burning

All kinds of Minnesota ag fibers, called biomass, can be used for fuel. The University of Minnesota is experimenting with burning oat hulls on the Twin Cities campus, and the Morris campus plans to gasify corn stover. AURI is a leader in this emerging sector, tackling technical problems such as energy content and burn efficiency, and biomass handling, processing and storage.

Ethanol from almost anything

Many types of plant materials supply starch that can be fermented to make ethanol.

Plastic and other petro subs

If there's one word that describes the future of ag fibers, it's plastics. There's intense research underway on refining plant materials for all the things that are now made from petroleum, including polymers, packaging films, foams, adhesives, building materials, textiles and a host of other manufactured goods.

Would-be wood

Ag fibers can also be used as alternatives to wood for making paper, oriented strand board, and other wood products.

Little bits

Ag fibers such as beet pulp and DDGS are a source of high value pharmaceutical sugars.

From waste to watts

Minnesota growers may be first in country to gasify grass-seed chaff for electricity

BY DAN LEMKE

Grand Forks, ND — The acrid smell of burning grass wafts through the brisk October air as researchers scurry around a gauge-laden apparatus on a semi-trailer. This small-scale gasifier is testing grass-seed chaff as a potential fuel source for electrical generation.

If it works, Northern Excellence Seed, LLC, might fuel its own seed-cleaning plant — reducing or eliminating a $40,000 annual electric bill. More than 40 growers — primarily from Minnesota's Lake of the Woods and Roseau counties — produce grass seed for Northern Excellence, including ryegrass, Kentucky bluegrass, timothy and native grasses.

AURI's Center for Producer-Owned Energy helped sponsor the five-day test that, if successful, could go beyond fueling one plant to charging up an entire community.

Good gas

Grass biomass smolders inside the mobile gasification unit, while gauges and sensors capture data on hydrogen, oxygen, methane and carbon dioxide output. "This is some of the best gas we've seen," says researcher Kyle Martin while checking readings.

The remark draws a smile from Brent Benike, Northern Excellence Seed general manager who journeyed three hours from Williams, Minn. to Grand Forks, N.D. to witness the burn. The test is being conducted by the Energy & Environmental Research Center at the University of North Dakota in Grand Forks.

Gasification converts solid materials into synthetic gas that can be burned like natural gas in a furnace, turbine or engine. In this case, two types of grass-seed chaff are being tested — from ryegrass and bluegrass. "We're

More than 40 northern Minnesota farms, primarily in Roseau and Lake of the Woods counties, harvest grass seed for Northern Excellence Seed. The area's cool climate is near perfect for growing grass.

Brent Benike, general manager of Northern Excellence Seed, says grass chaff that is now burned as waste could be burned as energy. "Given the whole energy situation in the United States ... the timing is definitely right."

burning the screenings (as waste) anyway, why not capture the energy?" Benike said.

"Right now we're getting better quality gas with ryegrass than we can get with wood chips," says Darren Schmidt, EERC research manager who specializes in biomass. He is evaluating the grass's emissions, ash and Btu value.

Cool days, cooler nights

Northern Excellence Seed farmers benefit from nearly perfect grass-growing climate — moderately cool days and even cooler nights — because of their proximity to the 950,000-acre Lake of the Woods. Along with Oregon and Washington, Minnesota is a national leader in grass-seed production.

Perennial grasses produce seeds that are harvested in early summer. The seed head is stripped from the stem and hauled to a seed-cleaning plant where seed is separated from chaff. At the Northern Excellence plant in Williams, seeds are then bagged, shipped across the globe, and sold for home and commercial lawns.

The left-over screenings — about 1.25 million pounds — are hauled to a landfill and burned. Benike estimates that Northern Excellence will generate well over 2 million pounds of screenings in 2006 — enough to be a reliable biomass-energy source.

"Given the whole energy situation in the United States … the timing is definitely right." Benike says. "It's renewable, we're not bringing it in from the Middle East."

From India to Lake of the Woods

The chaff charring in EERC's gasification chamber demonstrates a new technology developed in India. The 100-kilowatt gasifier uses suction to capture gas that is cleaned by a scrubber. The gas could then be run through an engine or turbine to produce heat or electricity.

Northern Excellence is considering installing a similar gasifier at its plant. The growers could save money "by not having to haul screenings away," says Michael Sparby, AURI project developer. Also, "depending on the size of the gasifier brought in, there could be payback in about four to five years just in energy savings."

"We need to determine the number of tons per hour that it takes (to run the gasifier), or if we have to bring in biomass from the outside," Benike says. "We'll see if this is the size gasifier we would need or if we could bring in a bigger one to power the whole town."

With the screenings yielding 140-Btu gas per cubic foot, it has good potential.

But Benike says positive results won't guarantee Northern Excellence will install a gasifier, as a 100-kilowatt unit would cost more than $150,000. "It still hinges on funding. We're not sure we want to chew the whole thing ourselves. But it could save labor, fuel, disposal costs, we would gain energy and, if it's large enough, we'd gain energy for the whole community." ■

Waste not: SOYBEANS

PHOTOS BY ROLF HAGBERG

BY E.M. MORRISON

Minnesota growers raise more than one billion dollars worth of soybeans a year. About half of Minnesota's bean crop is exported, and the rest is processed for oil and meal. One in four bushels of soybeans feeds livestock. Soybeans are also used for food and an amazing array of consumer and industrial products.

Soybean oil

Oil is the main product of the soybean crushing industry. About 70 percent of soybean oil refined in Minnesota is used as food, especially cooking oil. The rest is refined for countless industrial products, such as paint, ink, adhesives, lubricants, solvents, industrial cleaners and plastics — to name just a few. Soybean oil is also found in hundreds of everyday consumer items, like candles, cosmetics, household cleaning products, engine oils and biodiesel fuel.

Blend in biodiesel
Minnesota requires diesel fuel to be blended with two-percent biodiesel oil. Biodiesel, which can be made from vegetable oil, animal fats or recycled greases, reduces tailpipe and particulate emissions. Tax incentives are expected to significantly increase biodiesel demand. Minnesota's three biodiesel facilities in Brewster, Redwood Falls and Albert Lea have a total annual refining capacity of more than 60 million gallons.

Glitzy glycerin
A coproduct of biodiesel production, glycerin is used in cosmetics, liquid soap, antifreeze, inks and lubricants. It's also used in livestock feed, where it increases the energy value and makes the feed easier to handle. A Minnesota company is blending glycerin with feather meal to make beef and dairy supplements.

Soap story
A low-value coproduct of soybean oil processing, soapstock is a gummy, amber-colored material used for animal feed, soap and lubricants. It also suppresses road dust and controls pig manure odors. It can be burned to power turbines, too.

Making it stick
Surfactants made from soybean soapstock improve the effectiveness of herbicides by making them adhere to the plants. A leading soy surfactant, Preference, is made by Minnesota-based Agriliance.

Lecithin again
A coproduct of soybean oil processing, lecithin is used as a powdered ingredient in foods such as cake mixes, cookies, crackers, rolls, breads, donuts, instant beverages, margarine and infant formula. It's also used in pharmaceuticals, cosmetics, paints and inks, rubber and plastics. SoyMor in Albert Lea, Minn., operates a lecithin fractionation facility that makes purified lecithin, sterols and glycerin.

Soybean meal

Soybean meal, the most important coproduct of soybean crushing, supports Minnesota's $4 billion livestock industry. Farm-raised animals eat nearly two million tons of soybean meal a year. As biodiesel demand grows, supplies of soybean meal will increase, spurring the development of new uses.

A fraction of its former self
Soybean meal can be broken into higher-value specialty sugars and other components that are used in foods and medicines.

Hulls

Soybean hulls are used mainly as livestock feed. New uses include animal bedding, paper, and fuel.

Straw beds
Soybean straw can be used as bedding material in compost barns.

Volumes of versatility

Glycerin is already used in hundreds of products but an increasing supply of this biodiesel byproduct could open more markets

BY DAN LEMKE

Marshall, Minn. — Glycerin is one of nature's most versatile substances, with uses ranging from soap to candy to industrial lubricant. Any surplus glycerin, a biodiesel byproduct, is quickly consumed by market demand.

But that could change as the biodiesel industry grows, says Rose Patzer, a chemist at AURI's fats and oils lab in Marshall. Already Minnesota is capable of producing about 60 million gallons of biodiesel annually and "as more biodiesel plants start operating around the country, there is going to be more glycerin flooding the market and affecting the price," she says.

So AURI and organizations such as the American Oil Chemists Society are searching for more uses for the multi-faceted substance.

Glycerin can be produced by transesterification, which converts oil or animal fat to biodiesel. Reacting 100 pounds of oil or fat with 10 pounds of methanol yields about 100 pounds of biodiesel and 10 pounds of the clear, odorless liquid glycerin.

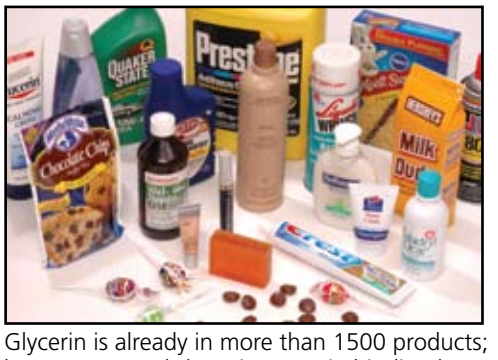
The biodiesel coproduct has more than 1500 uses — primarily in candy, cake mixes, medicines, lotions, shampoo, soaps, detergents and makeup. Industrial uses are also expanding — in emollients, lubricants, solvents and chemical-dispersing products.

AURI has been working with Central Bi-Products in Redwood Falls, Minn., on a patented process that uses glycerin to increase feather-meal density so the feed ingredient can be shipped farther to more markets. Central Bi-Products affiliate FUMPA Biofuels produces three million of biodiesel annually. AURI has also evaluated glycerin's combustibility as a potential fuel source.

"Glycerin is going to be a revenue stream" for biodiesel refiners, says Chuck Neece, Central Bi-Products research and development director. "The industrial uses keep opening up … including antifreeze, even a plane de-icer. The industrial markets don't pay the same as the personal products, but they will pay a good price for crude glycerin."

Neece says personal care and pharmaceutical buyers may pay up to 50 cents a pound for refined glycerin, while industrial market may pay only 15 to 25 cents per pound for crude glycerin. However, with the equipment expense needed to refine glycerin to personal care standards, processors may find better price margins with crude glycerin — if all the methanol is stripped out. Methanol in glycerin renders it virtually valueless.

Neece says he expects the higher-paying but smaller personal-care market to be saturated first, leaving more opportunity in the larger industrial market. ■



Glycerin is already in more than 1500 products; but an expected sharp increase in biodiesel production, which produces glycerin, is prompting a search for even more uses.

Penny-wise fuel

Two entrepreneurs pieced together a small biodiesel refinery that will serve local market

BY DAN LEMKE

Ironton, Minn. — Jay Idzorek and Ryan Hunt are thinking small. Still, they have big plans for their biodiesel business.

The partners own Green Range Renewable Energy, a small-scale biodiesel refinery that has grown from a garage experiment to a business that plans to sell biodiesel directly to truckers and motorists.

Located in Ironton's industrial park, the refinery is a modest green building flanked by liquid storage tanks. Inside, a biodiesel reactor that Idzorek and Hunt cobbled together will produce 800-gallon batches of the soybean-based fuel per day. Tiny by industry standards, the Green Range plant will only generate about a quarter-million gallons per year, but Hunt and Idzorek say it has great potential.

Rather than dumping biodiesel into the bulk market, Green Range is bringing the renewable fuel directly to customers. The vertically-integrated business will install a fuel pump at the refinery to sell biodiesel direct to trucking fleets.

"The bulk business doesn't look real profitable for us because we can't compete," Idzorek says. Most of the year, Green Range will market straight biodiesel with little if any petroleum fuel mixed in. "It makes the most sense for us to sell our product, not petroleum. Since we're producing biodiesel, let's sell biodiesel."

Garage beginnings

Idzorek first heard about biodiesel three years ago. After reading a do-it-yourself book on making the fuel, the 52-year-old construction worker collected waste grease and started producing biodiesel in his garage for his own use.

In 2005, Idzorek started thinking bigger.

He met Ryan Hunt, a chemical engineer, through a mutual friend in the solar heating business. The two schemed, then pieced together a batch biodiesel reactor with "a lot of sweat equity," Idzorek says. Locating used equipment, swapping items, recycling parts and even purchasing pieces off EBay, the thrifty partners built the reactor and launched Green Range Renewable Energy last fall.

From their Highway 210 location, they intend to serve a small market between Brainerd and Duluth. Several trucking fleets and other consumers have expressed interest, as petroleum diesel prices remain high.

Price incentive

"The timing has been excellent," Hunt says. Two years ago the project would not have worked because of lower fuel prices and minimal biodiesel awareness, he says. Now, "there are a lot more people who are willing to try it. Just about everyone I talk to would be willing to use it and spend their money locally."

"Energy in any form is saleable in this day and age," Idzorek adds, "particularly one that flows right into the infrastructure that's already in place."

Green Range is registered with the National Biodiesel Board, has worked with a current Minnesota biodiesel manufacturer and is receiving technical assistance from AURI's fats and oils lab in Marshall. Idzorek and Hunt are fine-tuning their process before embarking on full production. But even at full capacity, the goal is to stay small and not attract too much attention from competitors.

"We hope to service a small market," Idzorek says, "but go all the way from production to customer." ■

PHOTO BY DAN LEMKE

Ryan Hunt (left) and Jay Idzorek, owners of Green Range Renewable Energy, pieced together used equipment to make a small-batch biodiesel reactor. They plan to sell biodiesel directly to consumers.

PHOTO BY ROLF HAGBERG

Frosty FOE

Experts advise using 100-percent biodiesel in warm weather only

BY DAN LEMKE

Cold temperatures are not biodiesel's friend. In fact B-100, or 100-percent biodiesel, starts to cloud and flow poorly when the temperature reaches freezing. For that reason, blends of more than 20-percent biodiesel are not recommended during cold months.

"If you're running even a B-20 blend in Minnesota, you're going to have fuel management issues when it's cold," says Ken Bickel of the Center for Diesel Research at the University of Minnesota. "You may have to look at using additives or using more number-1 diesel fuel in your diesel blend."

Bickel says quality number-1 diesel is good to about 40 degrees below zero before cold flow is impacted. Adding biodiesel will raise the cloud point. A 20-percent biodiesel blend will raise the cloud point of number-2 diesel by about 3 to 7 degrees, he says. A 2-percent blend, such as that currently sold in Minnesota, has virtually no impact on cold-flow properties.

"Biodiesel's cold flow characteristics are heavily dependent upon the quality of the base fuel," Bickel says.

For more guidelines on using biodiesel blends above 20 pecent, see the National Biodiesel Board's Web site: www.biodiesel.org ■

Sans the trans

A new FDA rule requires that trans fats be identified on nutritional labels, prompting food companies to find alternatives

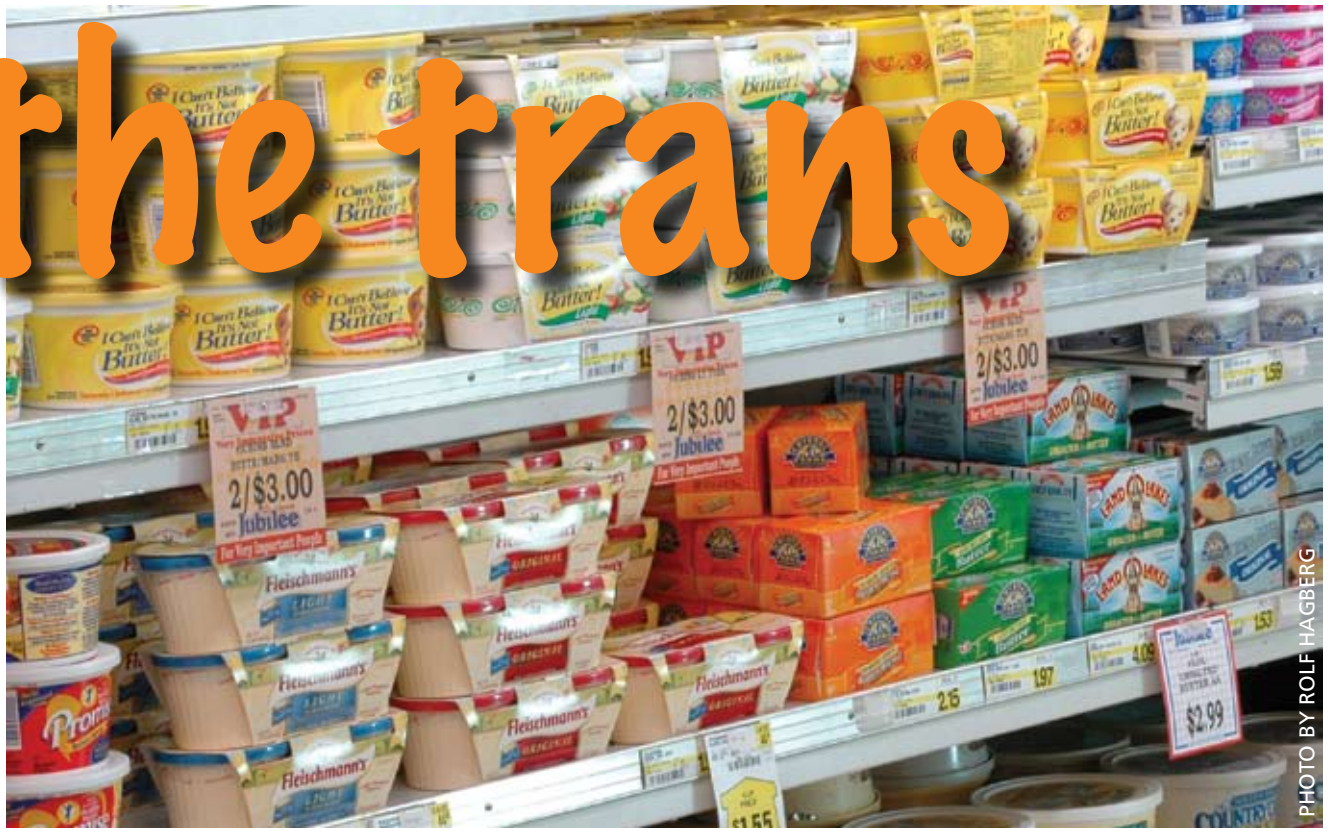


PHOTO BY ROLF HAGBERG

BY CINDY GREEN

Another culpable fat is being exposed.

On New Years Day, a U.S. Food and Drug Administration rule goes into effect requiring trans fat content be listed on all nutritional labels, along with total fat and saturated fat. Common in margarines and processed foods, trans fats have ill effects on blood cholesterol and are linked to coronary heart disease. They are in ingredients like "partially hydrogenated" vegetable oil.

With the new label requirements, AURI is stepping up services to affected small businesses. AURI's oils lab in Marshall has installed gas-liquid chromatographic capability to test for trans-fats and Charan Wadhawan is designing new nutritional labels at AURI's food lab in Crookston.

"It's expensive for (small companies) to reformulate, to repackage, to do whole new labels — everything costs money," Wadhawan says. When the FDA wrote the trans-fat-label rule three years ago, it predicted initial costs to the U.S. food industry would approach $140 to $150 million, according to the agency's Web site.

But the FDA also estimated that, within three years, the labeling will prevent 600 to 1200 heart attacks, save 250 to 500 lives, and save up to $1.8 billion annually in medical and related costs.

Seeking alternatives

Shelf-stable cookies, cakes, biscuits, donuts and other baked goods have typically been heavy users of hydrogenated oils that can withstand high heats and don't easily turn rancid. Crackers "stay crispy forever because of the functionality of hydrogenated fats," Wadhawan says.

Many of her clients target a health-conscious, natural-food market niche such as French Meadow Bakery of Minneapolis. She is helping the organic bakery design a nutritious trans-fat free cookie. "When you use unsaturated oil instead of hydrogenated fat, the texture is compromised and the shelf life is reduced — it can become rancid and lose flavor."

But with a little ingenuity, substitutions are available. "In some cases, you can blend liquid oils with emulsifiers to get the same texture as you would from hydrogenated fat — like lecithin or monodiglycerides that a lot of people think sounds bad but it's an emulsifier so it's not bad for you."

"Tropical oils (such as palm oil and cocoa butter) can also be used. They don't have trans fats, but they are saturated," Wadhawan says. "I would recommend blending tropical oils with liquid oils to use in place of hydrogenated fats — that would bring down the saturated fat content."

Competing oils

"Soybean oil is the most prominent oil in the U.S. today," Norris says. "We have a lot of it and it's cheap." The problem is, "the linolenic acid in soybean oil is highly unstable to heat and prone to oxidation, so when we put it into a commercial product, we add hydrogen. Up to 70 percent of the soybean oil in prepared food is hydrogenated."

However, Mike Youngerberg of the Minnesota Soybean Growers Association says that "to prepare for the trans fat issue, the soybean industry launched 'The New Bean Initiative,' which has resulted in soybean varieties that have less linolenic acid."

Corn is lower than soy in linolenic acid but also more costly. Both have saturated fat — 14 to 15 percent for soybean oil and almost 13 percent for corn. Canola is only 7 percent saturated fat but needs hydrogenation for most commercial uses.

The National Sunflower Association has been touting an alternative — the sunflower hybrid NuSun™, which produces shelf-stable, trans-fat-free oil that can withstand high heat and is only 9 percent saturate fat. The oil "has less than 1 percent linolenic acid, so you don't have to do much to it — to put it in prepared foods," Norris says.

For the past three years, major national snack-food companies have been increasing NuSun use in chips, crackers and other snack foods. (see "Sunny Alternative," page 12) AURI supported clinical trials that showed using NuSun in a typical American diet results in lower total and LDL cholesterol.

Cottonseed oil is another popular choice for snack foods as "it's more stable than soybean oil," Norris says, but it is about 26 percent saturated fat. Olive oil, by contrast, is about 17 percent saturated fat and 72.5 percent monounsaturated, but it smokes at a low temperature, which can impart an undesirable taste in fried or processed foods.

Wadawan says some companies are experimenting with "interesterified" oils. "They are not solid, but the structure is modified. It's good fat … regular oils that go through a physical process that rearranges the fatty acids … resulting in customized melting characteristics."

There are more designer fats entering the market, Norris says. Enova™, derived from soy and canola oil, was introduced about a year ago. "This high-diacylglycerols oil is metabolized differently. It has calories like fat, but it is not deposited in the body."

Also, several years ago, AURI helped Source Food Technology of Minneapolis do clinical tests on the designer oil-blend Appetize, now called Nextra™. The oil, made with a patented purification process developed at General Mills, is trans fat free and can withstand high frying temperatures.

The evolving nutritional label

Implementing the trans fat rule was not a quick federal government decision; it's the first significant nutritional label change since 1993. "Trans fat issues have been around since the 70s; what is new is the evolution of information over the years," Norris says. While early research was spotty and inconclusive, current "data does show it has difficulties with heart disease," Norris says. (see "Fat Facts," page 11)

The Center for Science in the Public Interest, a consumer advocacy group, petitioned the FDA to label trans fat in 1994, and amended the petition in 1998. The FDA issued a proposed rule in 1999 and, over the next three years, received more than 2700 public comments, reviewed scientific studies and consulted experts. The final trans-fat labeling rule was defined in 2003 and food companies were given until January 2006 to comply.

Some companies quickly started adapting their recipes. Frito Lay, for example, has been using NuSun since 2003. Others have held out for the mandate's effective date.

As of January 1, 2006, trans fat content must be listed on a separate line on nutritional labels under saturated fats. While total and saturated fat's Daily Value (recommended limit) is also identified, the FDA hasn't established a DV for trans fat.

One of AURI's clients, Cedar Summit Dairy of New Prague, recently tested its organic yogurts, flavored milk, cheese

and ice cream for trans fats at the Marshall lab, then Wadhawan designed a new nutritional label. "The company was able to list 0 trans fats" even though small amounts of trans fats naturally occur in dairy," Wadhawan says. "If it's less than a half gram per serving, then it's labeled 0 grams." That's why partially-hydrogenated oils may show up on the ingredient list of a 0-trans-fat labeled product.

The new labeling requirements do not apply to cafeteria or restaurant food. Almost all fast-food chains deep-fry foods in hydrogenated oils. "Eating one doughnut at breakfast (3.2 grams trans fatty acids) and a large order of french fries at lunch (6.8 grams TFA) adds 10 grams of trans fatty acids to one's diet," claims the American Heart Association Web site.

Butter or margarine?

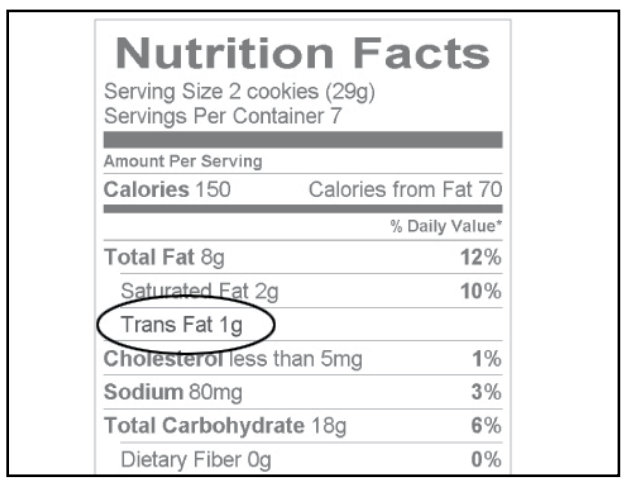
The trans fat revelation's see-saw effect is that hard-stick margarine is no longer considered a healthy alternative to saturated-fat-laden butter. Hydrogenation is what gives vegetable oils the firm, butter-like quality."

"There are a number of spreads that don't use trans fats, but we don't call them margarines," Norris says. "Margarine standards require it to have so much fat (at least 80 percent). Spreads can have as much as 75 percent water."

A variety of spreads are filling up dairy cases once dominated by butter and margarine. Most have high water content. For example, 30 percent of "I Can't Believe It's Not Butter" spread is non-fat filler; as is 40 percent of Bertolli Light olive oil spread and 51 percent of Weight Watchers Canola Spread. All have 0 trans-fat grams.

Companies such as Land O'Lakes are also combining butter with canola and other unsaturated oils. The result is a spread that does not need hydrogenation because the butter gives it firmness, yet it is lower in saturated fats with the canola addition, and it still has a natural butter taste.

To be sure, the nutritional label of any new product to hit the grocer's shelf this year is not likely to have any number but "0" on the trans fats line. ■



Fat facts

BY CINDY GREEN

Good fats, bad fats, what's the difference? They all store energy in our fat cells that will bulge over our waistbands if we stockpile too much. In moderation, fats are essential for good health — helping us absorb vitamins and replenish cells.

But some fats carry more bad baggage than good; they can raise low-density lipoprotein (LDL) or "bad" cholesterol, and lower high-density lipoprotein (HDL) or "good" cholesterol — jeopardizing hearth health.

To separate the villains from the helpers, here's a simple guide to fats:

Fat anatomy

The term "fat" is used interchangeably with "fatty acids." There are three types — saturated, monounsaturated and polyunsaturated. All are chains of carbon molecules with hydrogen atoms attached.

The abundance of hydrogen atoms and how they're attached differentiates the three main fatty-acid types. Some have hydrogen atoms clinging all around the carbon chains — as much as they can hold; they are called "saturated" fats. Fatty acids with missing pairs of hydrogen atoms are "unsaturated" fats; if one pair is missing on each chain it's "monounsaturated" and if multiple pairs are missing it's "polyunsaturated."

Generally fat is a mixture of all three types, although animal fats are predominantly saturated and plant-derived oils are mostly unsaturated. Some seafoods are also unsaturated.

Detecting saturates, unsaturates

Saturated fats are found in animal and dairy products, such as meat and whole milk, and in some plant-based oils, such as coconut and palm oil and cocoa butter. Saturates are generally solid at room temperature and don't combine with oxygen, so they don't easily turn rancid.

Monounsaturates are liquid at room temperature but start to solidify or become cloudy in the refrigerator, such as canola, olive and peanut oils. Avocados and nuts also contain monounsaturated fat.

Polyunsaturates stay liquid in and out of the refrigerator and are found in safflower, sesame, sunflower, corn and soybean oils, some nuts, seeds, and fatty fish such as salmon and herring. They are the most susceptible to combining with oxygen and becoming rancid.

Enter trans fats

Although small amounts of trans fats occur naturally in some meat and dairy products, most is manufactured. Hydrogen atoms are pumped into unsaturated liquid fats to make them solid at room temperature — a process called "partial hydrogenation."

"Trans" means hydrogen-atom pairs are on opposite sides of the carbon chain (rather than paired on one side as other fatty acids are structured). Although unhealthy trans fats are being eliminated from many products, they are common in margarines, shortening, snack foods, crackers, baked goods, fried foods and even energy and nutrition bars.

The cholesterol effect

Whether a fat is considered "bad" depends on how it affects cholesterol — both the "good" HDL and "bad" LDL types.

Saturated fats have been shown to increase LDL cholesterol, which increases the risk of coronary heart disease. The American Heart Association recommends limiting saturated fats to 7 to 10 percent of total calories and less if a person has heart disease.

"Trans fats pose an even higher risk of heart disease than saturated fats," says Charan Wadhawan, AURI food scientist. Some scientists say trans fats raise LDL more than saturates — and go a step further by lowering good HDLs.

The FDA has not established any recommended level of trans fats and, as of January 1, 2006, requires that trans fat content be listed on all nutritional labels. The 2005 U.S. Dietary Guidelines recommend keeping trans-fat consumption as low as possible. ■

AURI GUIDE TO SERVICES

A nonprofit corporation created to strengthen rural Minnesota's economy, AURI helps businesses respond to market opportunities with new and value-added uses for agricultural goods. The Institute builds working partnerships with business innovators, agricultural groups and researchers, and provides technical support to clients conducting new product research and development.

AURI programs are available to legally-organized businesses or cooperatives with projects that have the potential to create new uses or new markets for Minnesota agricultural commodities. AURI assistance is designed for the early stages of a product's life cycle, while an element of feasibility is yet to be determined.

Project proposals are evaluated on the following criteria:
- Innovation/uniqueness
- Market viability
- Use of Minnesota commodities
- Number of farmer-producers impacted
- Amount of value added from further processing
- Economic impact
- Cost savings

Programs are designed to assist with:
- Identifying emerging value-added opportunities
- Developing innovative commodity-based products
- Developing production processes for feasible products
- Promoting products developed with AURI technical assistance
- Providing resources to bring new products and processes to the marketplace

Assistance may include:
- Access to AURI's scientific and business staff
- Access to laboratory and pilot plant facilities
- Product development and feasibility testing
- Process evaluation and improvement
- Technology transfer and applied research
- Business needs evaluation
- Links to available resources
- Potential for grant funds to qualifying applicants

AURI provides resources proportionate to the project's impact. Smaller-impact projects may be eligible for technical assistance only, while projects with industry-wide impact may be eligible for financial assistance.

AURI Facilities

AURI operates several laboratories:
- Coproducts Utilization Laboratory and Pilot Plant, Waseca
- Fats and Oils Laboratory, Marshall
- Meat Laboratory, Marshall

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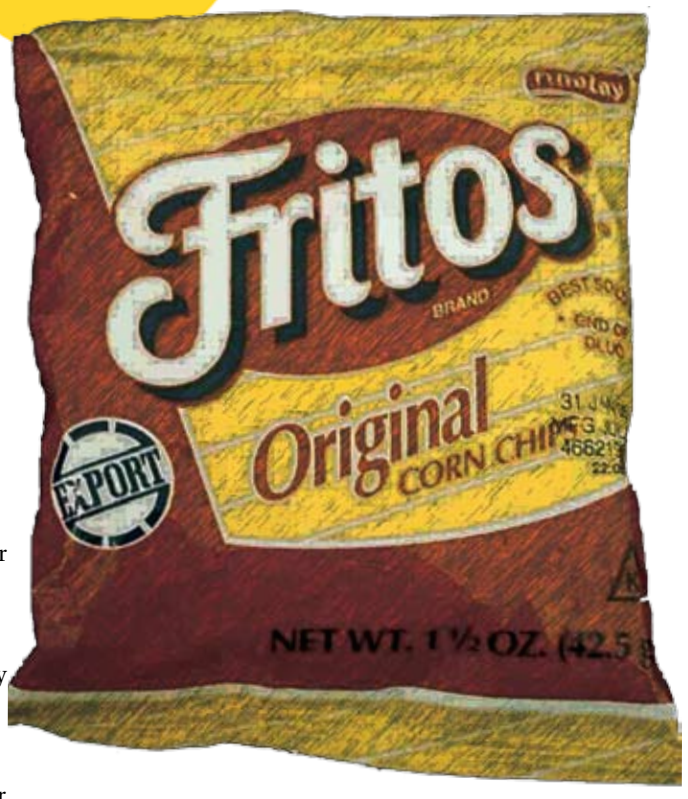

BY CINDY GREEN

A hip new sunflower hybrid — NuSun™ — produces shelf-stable oil without hydrogenation.

That's important now that trans fats are showing up on food labels. Major food companies are embracing alternatives to trans-fat-laden hydrogenated oil.

"We don't know how many products we're in now," says Larry Kleingartner, head of the National Sunflower Association (NSA) in Bismark, N.D. "Some companies protect that information; but some want to make a big splash about it." Frito Lay completely converted to non-hydrogenated oils like NuSun in 2003, and Old Dutch and Barrel O'Fun have also been using it in their popular snack foods.

"Old Dutch's kettle chips are awesome," Kleingartner says. "They talk about using the best potatoes and they also mention that they exclusively use sunflower oil."

Many companies are still converting because of new label requirements. "We know that a number of companies were waiting until later this fall; some will make the switch in the next couple years."

Designer sunflowers

In 1995, the NSA made a commitment to designing a hybrid sunflower oil with a fatty-acid structure that would meet changing consumer and food-industry demands: "oil that had a pleasing taste, stability without needing partial hydrogenation and low-saturated fat levels," says the NSA's Web site. NuSun was developed through standard breeding without genetic modification and commercialized in 1998.

A bottled oil labeled NuSun is not on the market yet. "But when you see sunflower oil in a bottle, it's likely NuSun," Kleingartner says.

Premium price

Sunflower growers get a premium for NuSun. "It is generally sold for at least 50 cents more per hundredweight than traditional sunflower oil," Kleingartner says, and is $1.50 to $2-plus per hundredweight more than former export market prices.

NuSun's biggest competitors are corn and cottonseed oils, as both are shelf-stable without hydrogenation, Kleingartner says. "But we don't grow corn for oil — it's a byproduct. The same with cotton — it's not grown for its seed or oil."

"The advantage of sunflower is it's an oil seed that you can increase production of," as oil demand increases. "We only produce oil." Corn and cotton production, conversely, is set "by the demand for their food and fiber."

Trans fats losing global favor

Canada is establishing a trans fat label rule that is a little more restrictive; they have to add their trans and saturated fats together on the label, on a per-serving basis.

"So a food product has to be low in both trans and saturated fats to claim either," Kleingartner says. "That eliminates a number of oils — cotton, palm and, in some cases, corn." With 0 grams trans fats and 9 percent saturates, NuSun is just under the limit to make the claim.

"It's opening up a good market in Canada — some nice opportunities." Denmark also has a trans-fat labeling requirement "but we're not feeling any real activity because of that."

European consumers, who reject genetically-modified ag products, ironically have not yet embraced the trans-fat-free movement. "There are real contrasts in Europe. They don't care about saturates … they use palm oil that is about 60 percent saturated fat. But we do expect that at sometime they will embrace trans fats."

Short supply for expanding demand

Weather has not cooperated with NuSun's sharp demand increase. "Unfortunately (with 2004's cold summer) we had a horrible, horrible short crop that threw a wrench into the whole situation. We had to turn customers away last year, so we're basically starting all over. Once you turn someone away, they find another supply."

The 2005 crop is much better. "Yields are excellent. But you don't want to turn the spigot on, go full speed, then turn it off. Unfortunately, last year we had to."

A fast food future

"We see lots of potential in institutional food use," Kleingartner says. "That's an area that hasn't opened up yet. … There are no labeling requirements in food service or fast foods."

"Hospitals are telling patients to eliminate trans and saturates, but a majority of hospitals still use trans fats in their kitchens."

Brigham and Women's Hospital, a Harvard Medical School teaching hospital in Boston, decided to use NuSun several years ago after NSA did a cooking demonstration with fries, onion rings and fish. "They've been leading the charge on eliminating trans fats … not only for patients but in their main public dining hall."

"Finer restaurants will embrace," going trans-fat free, Kleingartner says. On the other hand, "McDonalds says basically our customers don't care. … But the Center for Science in the Public Interest is already marking (food chains) for their next battle." ■