



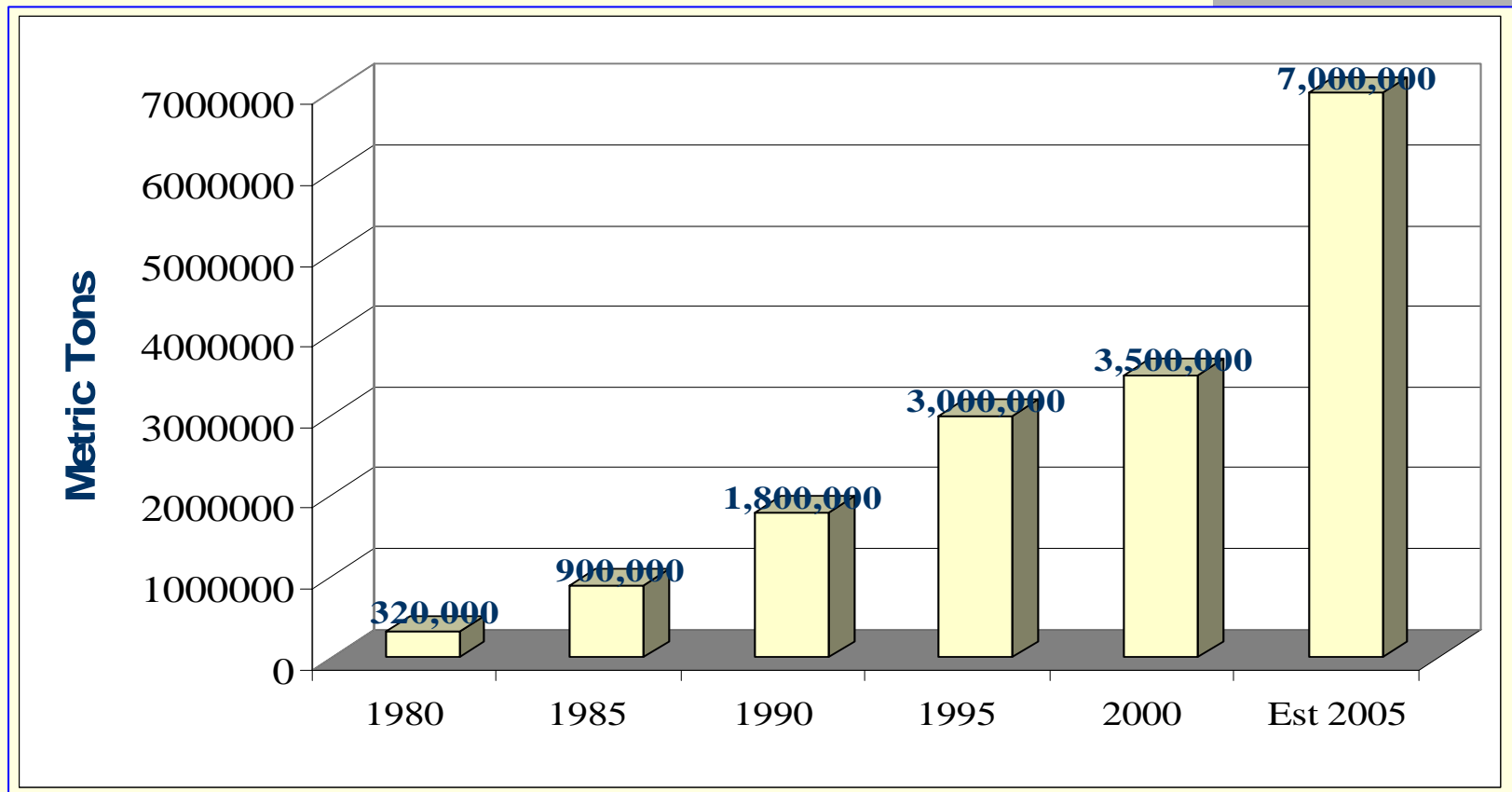
Research Sells DDGS

Dr. Jerry Shurson
Department of Animal Science
University of Minnesota

History of U of M Swine DDGS Research

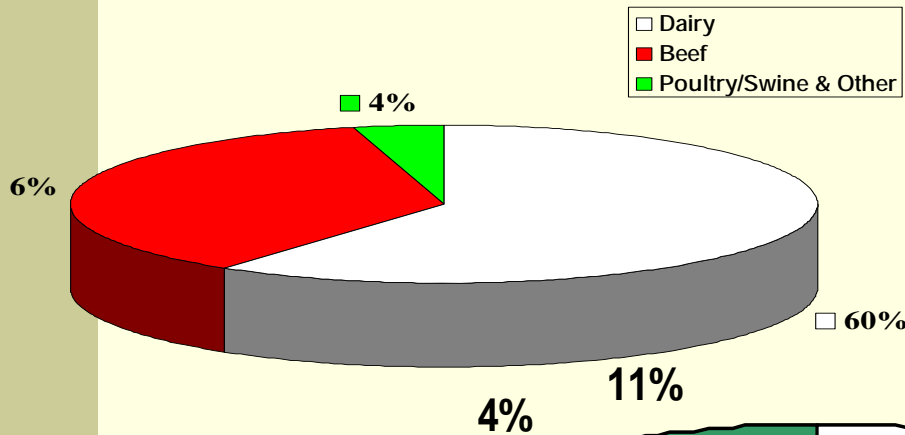
- Started with a meeting in 1997...
 - Steve Markham (Commodity Specialists Company)
 - John Goihl (Agri-Nutrition Services)
 - Dr. Jerry Shurson (U of M)
 - Several MN ethanol plant managers
- The meeting focused on 2 questions...
 - “What are we going to do with all of the DDGS?”
 - “Can it be fed to pigs?”
- A voluntary, internal checkoff program was implemented among interested MN and SD ethanol plants to collect funds to initiate swine research

North American DDGS Production

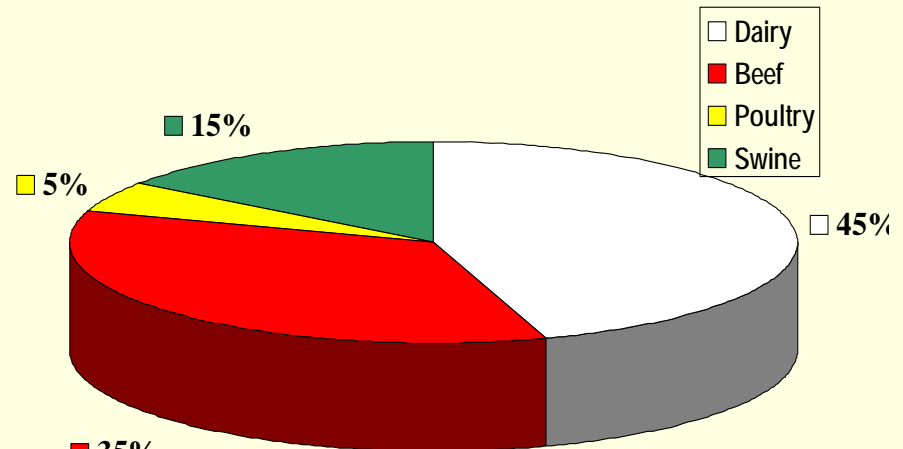


North American DDGS Consumption

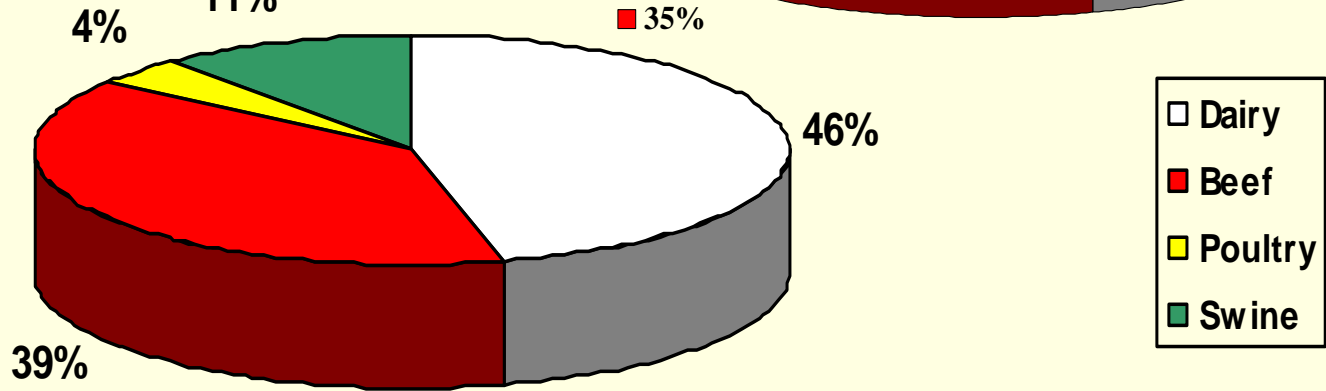
Estimate 2001



Estimate 2002



Estimate 2003



Key DDGS Marketing Questions

How well do you know your product?

Who are your customers or prospective customers?

How well do you know the needs of your customers?

Who makes the decision to feed DDGS?

What Nutritionists Want to Know

- Nutrient content and digestibility values for all feed ingredients they use.
- Predictability and consistency of nutrients and supply.
- Cost relative to competing ingredients.
- Maximum recommended feeding levels.
- Knowledge of limitations of use.
- Knowledge of potential safety or risk factors.
- Handling, transport, manufacturing, and storage characteristics.

Questions That Were Answered by Conducting U of M Swine DDGS Research Studies

Q: What is the nutrient content of DDGS produced by “new generation” fuel ethanol plants?

A: **Higher than values published in NRC (1998)**

Q: How does the nutrient content of “new generation” DDGS compare to “old generation” DDGS?

A: **It is higher in energy, amino acids, and P**

Q: How variable is the nutrient content of DDGS among plants?

A: **Nutrient variability is greater among plants vs. within plant but comparable to other by-product ingredients**

Questions That Were Answered by Conducting U of M Swine DDGS Research Studies

Q: What is the energy value of DDGS for swine?

A: **Equal to the energy value of corn**

Q: How digestible are amino acids in DDGS for swine?

A: **More digestible than “old generation” DDGS and values published in NRC (1998)**

Q: How digestible is the phosphorus in DDGS for swine?

A: **Highly digestible, allowing nutritionists to reduce dietary P supplementation, diet cost, and manure P levels**



Questions That Were Answered by Conducting U of M Swine DDGS Research Studies

Q: How much DDGS can be added to various swine diets to provide good performance?

A: Nursery pigs > 15 lbs	25%
Grow-finish pigs	20%
Pregnant sows	50%
Lactating sows	20%



Questions That Were Answered by Conducting U of M Swine DDGS Research Studies

Q: Are there any limitations of feeding DDGS to swine?

A: Yes.

- A short adaptation period is needed when feeding high DDGS diets to sows
- The high oil content of DDGS will reduce pork fat quality if fed at levels > 20% of the diet
- Digestible amino acid levels must be used if formulating diets containing > 10% DDGS
- The high N and digestible P content will limit the amount that be used in some swine diets

Questions That Were Answered by Conducting U of M Swine DDGS Research Studies

Q: What is environmental impact from feeding DDGS to swine?

A: **There are no negative impacts.**

- **Although some pork producers claim reduced odor from feeding DDGS diets**
 - **We could not show any improvement in our research studies**

- **Feeding high levels of DDGS (>20%) could potentially increase ammonia levels in pig barns**

- **Feeding DDGS will increase N content of manure**

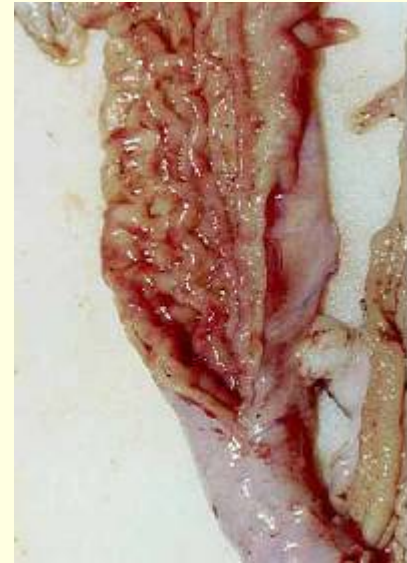
- **The high digestible P content will reduce the of P in manure**

Questions That Were Answered by Conducting Swine DDGS Research Studies

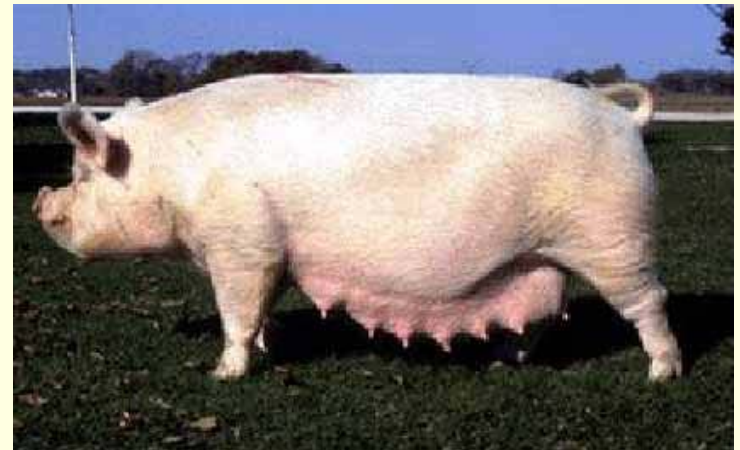
Q: Are there any other benefits from feeding DDGS to swine?

A: **Yes.**

- Improved gut health in pigs infected with ileitis



- Increased litter size in sows fed high levels of DDGS



U of M Research Funding Sources

- **Midwest DDGS Association**
 - **internal checkoff (\$0.10/ton DDGS)**
- MN Corn Growers Association
- MN Pork Producers Association
- IA Corn Growers Association
- CAMAS, Inc.
- Alharma
- IL Corn Growers Association
- SD Corn Growers Association
- Hubbard Milling



Telling the Story...

■ State and National Nutrition Conferences

- Michigan Professional Pork Producers Symposium - 2004
- AFIA Swine Nutrition Committee - 2003
- National Alternative Feed Ingredient Conference – 2003
- Iowa Institute for Coops Annual Meeting - 2003
- Minnesota Pork Congress - 2003
- Iowa Feed and Nutrition Conference – 2003
- Nebraska Pork Expo – 2003
- Iowa State University DDGS Workshops – 2003
- Midwest American Society of Animal Science Meetings
- MN Nutrition Conference - 2001, 2002
- Carolina Nutrition Conference - 2002
- NCGA Distiller's Grains Conference – MN, IA, TX (2002)
- MN Ag Expo - 2002
- Ethanol Co-products Workshop – Lincoln, NE (2001)
- Turtle Lake Pig Science Conference - 2000

Telling the Story...

- Regional and National Feed Companies
 - Ridley-Hubbard Milling – 2003
 - Land O' Lakes/Farmland Feed – 2003
 - ADM Alliance Nutrition – 2003
 - Standard Nutrition – 2003
 - Vita Plus – 2003
 - International Alltech Conference – 2003
 - DeKalb Feeds - 2003

National Hog Farmer

March 15, 2003

The Pork Business Authority

New CAFO Rules Target Large Units

Six Strategies to Cut Phosphorus

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alternative feedstuffs

by Jerry Shannon, University of Minnesota and John Gohl, Agri-Nutrition Services, St. Cloud, MN

Evaluating Distiller's Dried Grains with Solubles

The use of "new generation" distiller's dried grains with solubles (DDGS) in swine feeding programs is increasing dramatically.

New generation DDGS is a corn co-product produced by relatively new dry mill ethanol plants in the Midwest. It is nutritionally different from corn gluten feed and corn gluten meal produced by wet mill ethanol plants. This is an important distinction because some swine co-products are being marketed as DDGS

— but they are really different corn co-products produced under different processing methods. For example, one product being marketed as DDGS is made from gluten feed with some corn gluten meal added.

University of Minnesota research has shown that true DDGS is an excellent alternative feed ingredient for

swine in all phases of production. It is also a good value compared to the cost of the feed ingredients it partially replaces in typical swine diets — corn, soybean meal and distillers' phosphates. With a projected 50% increase in DDGS supply by 2005, supply will be plentiful throughout much of the Midwest.

Producers are most interested in the feed cost savings and other benefits DDGS offers. We'll discuss some questions related to the economic value of DDGS in some detail.

1. How does price of DDGS compare to corn, soybean meal and distillers' phosphates?

The price of DDGS like all other feed ingredients, is determined by a variety of external factors that affect supply and demand. Commodity indices establish the market price based on protein and energy values. DDGS prices track corn and soybean meal prices fairly closely.

New DDGS has traditionally been used more in the dairy industry. It has been valued more for its by-pass protein content than its energy value. However, simply being poor decision as results of protein when comparing the price of DDGS to other ingredients will under-value its energy and phosphate value and overvalue protein in swine feeds.

Phosphorus in the feed must represent a certain % of swine diets.

One of the main advantages of using DDGS in swine diets is its relatively high available phosphorus content (30%) compared to other grains and grain co-products. The high available phosphorus level makes swine diets to use less expensive

phosphate (e.g., distillers' phosphate) to reduce diet cost while meeting the pig's phosphorus needs.

The three nutrient categories of greatest economic importance in swine diets are energy, amino acids and phosphorus. Research at the University of Minnesota has shown that new generation DDGS has a high metabolizable energy (ME) value (1,237 kcal/lb) that is comparable to corn (1,250 kcal/lb). However, depending on the source, the energy value can be substantially lower.

For example, in a recent University of Minnesota report, the calculated ME value of DDGS obtained from an "old generation" ethanol plant was 1,420 kcal ME/lb, approximately 92% of the energy value of new generation DDGS. The National Research Council's "Nutrient Requirements of Swine" (2000 publication) lists the ME value of DDGS at 1,218 kcal/lb. 13% of the value obtained for new generation DDGS.

By using high quality, new generation DDGS, virtually no additional supplemental fat is needed to maintain desired dietary energy levels in typical swine soybean meal diets.

Recent economic analysis at Eastern State University suggests that diets containing 15% new generation DDGS (1,237 kcal/lb) could result in more than a \$1/pig increase in margin over feed costs compared to traditional corn-soybean meal diets.

3. What are the total and digestible amino acid values of year DDGS swine diets?

The total amino acid levels, especially lysine, in DDGS are important for determining the economic value. The higher the lysine, the more soybean meal it can replace in the diet. Like all feed ingredients, the nutrient content of DDGS varies among sources. However, once you've identified your



phos. value found in the Minnesota study and calculate values that are 30% below their average value. This range would be typical of the available lysine content of year DDGS swine diets (Table 1).

Using the nutrient values in Table 1, gross diets (34.0% total lysine) were formulated on a digestible amino acid and available phosphorus basis using 20% or 40% lysine of new generation DDGS. The composition and cost of these diets are shown in Table 2.

Compared to a typical corn-soybean meal diet containing 3% of synthetic lysine, adding 20% of DDGS to the complete feed will reduce diet cost by 16.0%. This cost savings is realized because adding 20% of DDGS to the diet will replace 17.7% of corn, 19.1% of soybean meal and 6.5% of 18.2% P distillers' phosphate using the ingredients' price level. Doubling the amount of DDGS will double the cost

of lysine + lysine, lysine, and lysine.

Table 3. Composition and Cost of Swine Diets Containing 15% DDGS and Formulated on Total Lysine and Phosphorus Basis or Digestible Lysine and Available Phosphorus Basis Compared to a Typical Corn-Soy Meal Diet Containing 3% of Synthetic Lysine.

Ingredient	Cost \$/lb		15% DDGS Formulated on a Total Lysine Basis		15% DDGS Formulated on a Digestible Lysine Basis	
	20% Lysine	40% Lysine	20% Lysine	40% Lysine	20% Lysine	40% Lysine
DDGS, lb	1,420	1,420	1,420	1,420	1,420	1,420
corn, lb	482	482	482	482	482	482
soybean meal, lb	24	24	24	24	24	24
distillers' phosphate, lb	4	4	4	4	4	4
lysine, lb	0	0	0	0	0	0
lysine HCl, lb	0	0	0	0	0	0
DM amino, lb	0	0	0	0	0	0
total	2,000	2,000	2,000	2,000	2,000	2,000
total cost	100.00	100.00	100.00	100.00	100.00	100.00
difference \$			-1.40	-1.40	-0.81	-0.81

Table 1. Average, 10% Below Average and 10% Above Average Total and Available Digestible Amino Acid Levels in DDGS.

Ingredient	Average 2002 Swine Feed		10% Below Average DDGS Swine Feed		10% Above Average Total and Available Digestible Amino Acid Levels in DDGS	
	lb/lb	lb/lb	lb/lb	lb/lb	lb/lb	lb/lb
ME, kcal/lb	1,500	1,500	1,500	1,500	1,500	1,500
Crude protein, %	21.0	21.2	21.2	21.7	21.7	21.7
Lysine, %	0.72	0.26	0.26	0.28	0.28	0.28
Available Dig. Lysine, %	0.30	0.30	0.30	0.40	0.40	0.40
Met-Lys, %	0.08	0.08	0.08	1.08	1.08	1.08
Available Dig. Meth-Lys, %	0.22	0.22	0.22	0.22	0.22	0.22
Protein, %	0.30	0.30	0.30	1.08	1.08	1.08
Available Dig. Threon, %	0.26	0.26	0.26	0.26	0.26	0.26
Protein, %	0.27	0.27	0.27	0.27	0.27	0.27
Available Dig. Meth, %	0.14	0.14	0.14	0.14	0.14	0.14
Protein, %	0.18	0.18	0.18	0.18	0.18	0.18
Met-Phosphorus, %	0.18	0.18	0.18	0.18	0.18	0.18
Met-Phosphorus, %	0.18	0.18	0.18	0.18	0.18	0.18

Table 2. Comparison of Diet Composition and Cost When Using Average, 10% Below Average, 10% Above Average Available Digestible Amino Acid Levels to Formulate Diets When Adding DDGS at 20% and 40% of the Diet Compared to a Typical Corn-Soy Meal Diet Containing 3% of Synthetic Lysine.

Ingredient	Cost \$/lb		10% Below Average DDGS Swine Feed		10% Above Average DDGS Swine Feed	
	20% Lysine	40% Lysine	20% Lysine	40% Lysine	20% Lysine	40% Lysine
DDGS, lb	1,420	1,420	1,420	1,420	1,420	1,420
corn, lb	1,398	1,398	1,398	1,398	1,398	1,398
soybean meal, lb	24	24	24	24	24	24
distillers' phosphate, lb	4	4	4	4	4	4
lysine, lb	0	0	0	0	0	0
lysine HCl, lb	0	0	0	0	0	0
DM amino, lb	0	0	0	0	0	0
total	2,000	2,000	2,000	2,000	2,000	2,000
total cost	100.00	100.00	100.00	100.00	100.00	100.00
difference \$			-0.14	-0.14	-0.38	-0.38

The Farmer

March 2003

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New, patented Roundup WeatherMAX™ was made for days like these.

IDEAL

TOO HOT

TOO DRY

TOO COLD



COVER STORY

Sell corn twice!

Make money feeding DDGS from the ethanol plants. ■ By Randy Frater and Lon Tassenaar

Glenn Graff, Southern, Minn., is cashing in on distillers dried grains and solubles (DDGS) — a feed byproduct from the production of ethanol.

Graff uses 75 tons of DDGS each month from the Ethanol 2000 plant in nearby Burlington, Minn., in a finishing ration for 2,000 head of Holstein who are to gain 2 pounds per day.

DDGS is definitely helping him do that. Packed with protein, energy, fat and other nutrients, DDGS is an excellent livestock feed. It can partially replace corn, soybean meal and distillers phosphates in livestock and poultry feeds and save money — anywhere from 60 cents to \$6 per ton in some cases.

After extensive research shows that DDGS is a healthy feed, too, it

was University of Minnesota (U of M) feed, for instance, feeding DDGS to high-reproductive sows and sows in late pregnancy increased litter size and minimal sow-toe phagocytosis levels.

For Midwest farmers, however, perhaps the best thing about feeding DDGS is that you get to sell your corn twice, says Arturo Garcia, South Dakota State University (SDSU) extension dairy specialist.

First you sell corn to an ethanol plant, which then uses it to produce the alcohol. You buy back DDGS, which has even greater feed value than corn, and use it in a livestock ration.

"It's like selling the corn a second time when you sell the milk or meat," Arturo says. "It's one of the benefits of DDGS."

Graff began using DDGS in 1998 to replace protein sources such as urea in soybean meal. He made the

switch due to price and performance.

"Part of it was dollars and cents," Graff says, doing the math on a spreadsheet. "When you compare the price of DDGS versus the price of corn, they're about the same, but if you compare the feed value, there's quite a difference."

"The DDGS price is based on the nutrients," but the fat level brings added benefit, so it's almost a give-away," he says.

PRODUCTION TO GROW

Currently, DDGS supplies are tight. Drought has cut corn supplies and raised the price of corn, making DDGS an even better buy. Ethanol plants in the Midwest are feeding such wastes throughout the United States and even Europe for the byproduct. At present, DDGS was selling for approximately \$180 per

\$100 per ton delivered in the region. DDGS production nationally is expected to at least double in the next two years as ethanol producers expand and build new plants, says Ralph Graubner, Minnesota Department of Agriculture marketing specialist.

Will the price for DDGS drop? Not one farmer here. If farmers who have used DDGS as an alternative to urea and soybean meal continue to use the product when the drought breaks, demand could stay high, says

Whatever happens to the DDGS price in the future, Dakota and Minnesota livestock and poultry flocks may always have a distinct advantage over competitors in other regions because they are closer to most of the nation's ethanol plants.

"South Dakota will become the cheapest place in the nation to feed livestock," predicts Lisa Richardson, South Dakota Corn Growers Association executive director.

By extension, Minnesota and

plants in the Midwest. Corn gluten feed and meal are produced by a wet milling process. ADM/Minneapolis Corn Processors in Marshall, Minn., is a wet mill plant.

Get professional help to bid your ration. DDGS is a good protein source in all rations. But there are limits to how much you can feed to different livestock species.

Compare prices. These are not wet prices to consider. One is wet vs. dry DDGS forms. Wet currently costs about \$25 per ton, dry is approximately \$19 to \$120 per ton delivered. However, the dry form is more convenient. To properly compare values, multiply the wet price by three to get the rough equivalent of dry price. Another thing to compare is the price of DDGS with the price of corn, soybean meal or other protein supplements. See the Internet links below for some calculators to compare prices.

Consider handling and storage situations. To use wet distiller grains, you usually must be close to an ethanol plant to economically transport the product and be able to use a semi load in as little as seven days during the summer. Otherwise, expansion plans may be spud. Baggging it can extend the shelf life. The dry form stores longer, especially when corn-

meal. ■

Tim DDGS. It is not all created equal. Different ethanol plants have different processing methods, which affect DDGS feed value. A good clue to feed quality is the color of the product. A golden color is best. A dark color means an indication of overheating. Protein analysis are available to livestock when DDGS has been overcooked. Ask your supplier for a complete nutrient profile. ■

MORE INFORMATION

Several Web sites are good sources of more DDGS information. The U of M has three research row-feeding DDGS to swine, poultry and cattle. Go to www.aggnet.uoregon.edu for reports.

SDSU feed and dairy DDGS research and a cost calculator can be found at www.sdstate.edu/foodfeed/dg.htm.

University of Illinois has a DDGS source ration research site at www.nrc.uisi.edu/pubs/paper/depdyt/depdyt.html.



DDGS can replace protein supplements in some livestock rations.

Hila Sokolov, director of operations and business development, Dakota Commodities, Fortland, S.D.

However, whenever the supply of one feed ingredient doubles, the market will change, says Steve Markham, union leader with Commodity Specialists Co., Minneapolis, Minn.

The European Commodity's research market currently accounts for about a quarter of Commodity Specialist's sales annually. Marshall can be down's not one expansion in that market segment. Therefore, supplies should remain available for Upper Midwest producers, he says.

The Chicago Board of Trade offers a clue to future DDGS prices. Though the DDGS price does not reflect one specific corn model, it tends to follow protein content, such as soybean meal.

"DDGS trends with other commodities," Markham says. "But it lags behind the Chicago Board of Trade by about six weeks."

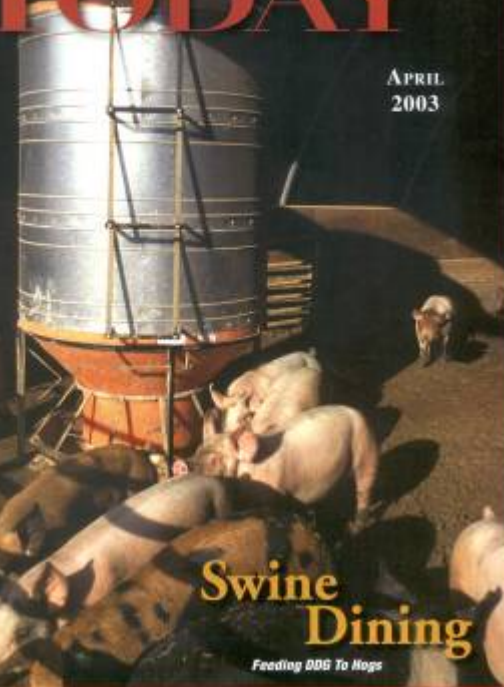
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Swine Dining

Feeding DGG To Hogs



King Van Zanten has been an advocate for ag ethanol and the ethanol industry since its birth with Jim Throckmorton at University of South Dakota, where his research is using ethanol. Right: Van Zanten's hog facility.



Photo by Steve Hest

Swine Dining

Feeding Distillers Grains To Hogs

If you are familiar with the term distillers dried grains with solubles (DDGS), chances are you know that by-products of the ethanol industry has been fed to beef and dairy cattle for years. What you may not know is DDGS can provide an economical partial replacement for corn and soybean meal in swine diets as well.

First, the basics. A hundred corn weights in pounds, and that corn is about 75% starch with the remaining amount being protein, fiber, fat and other nutrients. When starch is treated into ethanol at a distilld ethanol plant, the 75% starch is turned into about 2.7 gallons of ethanol, and the remaining starch comes out in a highly concentrated form product referred to as DDG and DDGS. Most of the auxiliary grain is dried short, which improves its availability and its ability to be shipped around the country economically. Some ethanol producers also distill the fibers and sell a portion of that distillers grain with a high moisture content, and that is referred to as very wet, wet distillers grain, WDG and WDDG.

By comparison, the corn feed by-product of the corn wet-milling industry is very glutin. When wet-milled plants process corn, they remove much of the starch, oil and protein, which are processed into other products. The resulting residue is called corn gluten and is also sold as a livestock feed. Though it is much lower in energy and protein value compared to distillers grain, corn gluten is still a good livestock feed.

King Van Zanten is a grain farmer and hog producer who has been feeding his hogs DDGS for the last three years and is very

satisfied with the results. Not only has feeding DDGS in his hogs helped improve the health of his pigs, it has given him a way to utilize a food product produced at an ethanol plant when it is one of the mainstays that Van Zanten, who revolutionarily analyzed ethanol feeding DDGS is not something he does just because he sees others in an ethanol plant.

After using DDGS in his hog system, Van Zanten found the feed with the ethanol by-product reduced digestive problems, such as ulcers, in his pigs by 70-90%. "I feel it's a premium quality feed. We get a better ration, cheaper, so that's like getting better food for less money. Plus, it's a dietary aid, and we give water back better health. And because of the economies and the better performance from the pigs, we get a better product to give to our consumers," he noted.

Van Zanten runs a three-year-old, South Dakota, with his wife Beth. They have three children, two sons, Alex and Andy, 25, and daughter, Dana, 20. Recently, their son Alex has come back home to actively join WDG and WDDG.

Recommended inclusion rates of DDGS for hog diets

FINISH	START FINISH	WEANERS
100% DDGS	100% DDGS	100% DDGS
90% DDGS	90% DDGS	90% DDGS
80% DDGS	80% DDGS	80% DDGS
70% DDGS	70% DDGS	70% DDGS
60% DDGS	60% DDGS	60% DDGS
50% DDGS	50% DDGS	50% DDGS
40% DDGS	40% DDGS	40% DDGS
30% DDGS	30% DDGS	30% DDGS
20% DDGS	20% DDGS	20% DDGS
10% DDGS	10% DDGS	10% DDGS
0% DDGS	0% DDGS	0% DDGS

Source: University of Minnesota

of farming operations. Van Zanten has been in the hog business for thirty years, which means he's witnessed many changes to the industry. One of those changes was a few years back when someone sold the pork industry that they wanted a leaner pork product. The hog producers to meet more hog production (see today's headline). This is not just increased stress on the hogs and they began to develop problems with their digestive systems. One of the changes was that a lot of interest in feeding DDGS to hogs. So far, all the feeding trials conducted in other countries have resulted in very good success rates in raising a significant amount of "lean" pork.

DDGS (Organizations like the U.S. Grains Council have also worked to promote DDGS as a product to be used by livestock producers in other countries.

Stament summed up his analysis by stating, "I believe that there is tremendous potential to increase DDGS use in the United States pork industry as well as increase the amount of DDGS that is exported to other countries."

Dr. Harold Tillett, Swine Feed Advisor, South Dakota, and the Land of O'Lakes Feed, underlines the importance of reporting DDGS in swine diets to work. The former noted significant cooperative success stories and their families.

Russ Havelin by Moore and Washington in Florida.

"If I had to guess, I'd say about half of the hogs in the eastern South Dakota, Minnesota and Iowa border area are being



King Zanten's hog facility is full. Not everyone DGG is.



Dr. Jerry Shelton speaks of a potential to expand use of ethanol in swine diets.

Swine Dining

Continued from page 10

feeding DDGS." There are 100,000 pigs in the eastern area currently (range from 100 to 500) per hog according to Havelin. Land of O'Lakes is using a minimum of 10% DDGS in grow-to-finish pigs, up to 20% for finishing hogs and 5% for nursing sows and nursery pigs.

Tillett believes that a DDGS supplier should provide information that shows:

- Crude protein: minimum of 26.5%
- Moisture: maximum of 12.0%
- Crude fat: minimum of 10.0%
- Crude fiber: maximum of 7.5%

"We have recently seen from a \$1.90 to \$2.00 per ton advantage for hog finishing diets containing 10% DDGS. We've succeeded in getting a product that has a higher value and a pleasant, cereal-like flavor. Our hogs have a slight better rate of gain and a potential for longer frame digestibility as well," Tillett noted.

One of the challenges that livestock producers face in dealing with the residues is DDGS characteristics. "There are three wet DDGS factors that create problems in DDGS characteristics: the quality of corn, inconsistency in the fermentation process and the amount of soluble starch in DDGS."

He continues to say that research has shown that diets are an immediate diversion to animals, hydrogen sulfide, at color changes or compared to traditional corn or soybean meal diets. "I have had many producers comment that the hogs used different when they are feeding DDGS. I think what they may be talking is the acid of the DDGS." Tillett

Swine Dining

Continued from page 10

and Land of O'Lakes also provides technical service to help pork producers learn the benefits of using DDGS in their hog diets.

Another company that offers similar services is Dakota Commodities. Dakota Commodities markets DDG under the brand name Dakota Gold and Dakota Gold Plus. The company offers its product nationwide. However, the majority of the Dakota Gold products are now being shipped by truck, which means the majority of the business is in close proximity to the ethanol plants they market for. Having local markets for DDG helps reduce transportation costs which benefits both DDG producers and the livestock finishers who use it.

Henry Shinde, Dakota Commodities Director of Marketing, has been with the company since 1989. Shinde says back then they only fed DDGS less than 10% of the DDGS being produced, now being fed in swine. "Food companies are now equally promoting the use of DDGS in swine diets," he noted.

One of the benefits of increasing the amount of DDGS used to create feed for all ethanol plants has to be the increase in ethanol plant output. In some cases, ethanol plants have to increase ethanol production to meet demand for ethanol. This increase in ethanol has also helped more the significant increase in DDGS ethanol production over the past few years.

"As the beginning, the main key for a feed ingredient to be incorporated into a swine ration was if the ingredient was priced low enough to reduce ration costs. However, as the market has evolved, many more producers have seen value factors which now give DDGS a higher value. Whether it be low value, although not protein, or better pig health resulting in significant savings in European drugs, or a reduction in pharmaceuticals, producers are willing to pay a higher value for the DDGS than in the past," Havelin said.

One of the main issues that may affect whether or not many hog producers use DDGS, beyond the potential health benefits, is the fact that feed ratios that include DDGS reduce the amount of phosphorus in hog rations. "The reduction in phosphorus content will have an even higher value if federal producers fail to regulate the

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Issue

Yum Yum!

Pigs and poultry add distillers' grains to their menus, opening markets for ethanol's leftovers

Some have called distillers' grains the ugly duckling of the ethanol industry. While farmers quit the last decade looking over ethanol and its promise as a new market, they largely ignored its No. 1 co-product.

Distillers' grains were from the start deemed a pain in the neck to handle and store. Early markets were limited to livestock farms located near ethanol plants to reduce transport costs for the wet, heavy grain. Early studies showing the byproduct's low digestibility and nutritional quality made cattle the preferred consumer.

Due to advancements in processing and handling, distillers' grains are beginning to shed their old feathers to become the darling of the ethanol industry. New research suggests distillers' dried grains with solubles (DDGS) fit well in swine diets, and problems with handling the byproduct have all but dried up due to new, efficient drying capabilities, making 10% to 12% moisture levels commonplace.

"DDGS is on the tip of the iceberg as a market," says Harry Swanson, director of marketing for Dakota Commodities, which sells distillers' co-products for several Midwest ethanol plants. "We are growing quickly both domestically and as an export market. Domestic markets, particularly poultry and swine, are becoming big buyers of DDGS."

Distillers' view. One bushel of corn produces 18 lb. of DDGS. Dry mill ethanol plants currently produce more than 3.8 million tons of DDGS annually. By 2004, USDA estimates that new plants coming on line will increase production to 9.5 million tons. Ethanol plants in Minnesota and South Dakota alone produce about 25% of the byproduct.

Currently, DDGS is priced as a protein source at about 14 per cent of protein (cheaper than soybean meal, or about \$45/ton). A 30 million gallon per year ethanol plant will produce 32,500 tons of the byproduct. That's enough to feed 380,000 cattle 3 lb. of DDGS per day.

When ethanol plants make ethanol, they use only the starch that makes up about 60% to 70% of the corn kernel. The remaining nutrients—protein, energy, fiber and phytonutrients (P)—make up DDGS. Historically, more than 85%

of DDGS produced has been fed to dairy and beef cattle as an economical protein supplement to ruminant diets. Dairy producers especially like DDGS because of the crude protein level—about 3.5 times higher than that of corn.

In the past, DDGS was not fed much to swine because of problems with inconsistent nutrient quality. Recent studies indicate that newer ethanol plants are controlling the problem, turning out DDGS with higher nutrient content and digestibility, reports Jerry Shannon, University of Minnesota animal scientist.

"A lot of plants have finally realized the value of distillers' grain and are making a good feed product," explains Randy Drost, general manager of A1-Corn Class Feed plant in Chariton, Mo., and chairman of the Midwest DDGS Association.

Growth rates. Feeding trials suggest DDGS contains undervalued growth factors that improve growth, reproduction and feed intake. Turkeys and chickens that were fed at least 30% DDGS in their diets showed improved growth and reproduction, Shannon says. Similarly, increased litter size and pig survivability have been seen as some feed a diet containing 5% corn DDGS compared with some fed a diet containing oats, oats and soybean meal.

If data appears there are compounds in corn DDGS that may provide some gut health benefits for pigs, Shannon adds. Producer field reports indicate that 5% to 10% DDGS in grower-finisher diets helps stabilize mortality and growth problems stemming from chronic gastrointestinal disease that is not prevented with antibiotic prophylaxis use.

"One of the things present in DDGS that makes it unique is yeast yeast, or yeast ash," Shannon says. "We know there are some special compounds in yeast cell walls that do have biological activity. They may enhance the immune system and promote growth and reproduction."

In addition, pork producers may be interested in distillers' grains to help their manure. For their hog manure, DDGS is high in available P but often have a greater P requirement than beef or dairy cattle. Simply put, more P in the byproduct gets used up by pigs and cows, and that

By Jeanne Berrick

Distillers' Grain Code

Confused by the acronyms used for distillers' grains? Here are some helpful explanations.

DD distillers' grain: After the starch in corn is fermented with selected yeasts and enzymes, the sweet fraction is added to produce alcohol (ethanol), and the remaining solids are screened and pressed to remove excess moisture. DD can be sold wet, at about 30% moisture, in cattle or pig feed and blended with soybean to create DDGS.



Each bushel of corn will produce 18 lb. of distillers' dried grains with solubles.

DDGS distillers' dried grains with solubles: The solubles in the (straw)—the liquid removed from the fermented corn, also called syrup—are added back to the solid residue (the distillers' grain fraction left over after fermentation). The product is dried further to 10% to 12% moisture. DDGS is the only form of distillers' grain being marketed to swine and poultry.

DDS distillers' dried grains: solubles. The solubles in the (straw) are considered to a nutrient at about 60% to 60% moisture. DDS is normally mixed with distillers' grain and then dried to produce DDGS.

mean less P in manure.

Distillers' byproducts carry several features that limit use in swine diets. The high fiber content certainly can't help pig food, and DDGS will have a lower metabolizable energy content due to less starch.

Market saturation. Producers don't even need to be near an ethanol plant today to have access to DDGS. Many local cooperatives are beginning to inventory it for their customers.

"Right now, only one-third of domestic dairy cows consume distillers' grains," Berrick says. "There is room for increase in the dairy feed market and room for huge increases in swine and poultry, as well as hogs and brood cows."

Adding 200 lb. of DDGS to 1 ton of complete corn-soy feed will replace about 177 lb. of corn, 20 lb. of soybean meal (at 44%) and 5 lb. of distillers' phosphorus. "It's a great fit for ethanol. If we displace even in broodstock ration, that leaves more corn available for the ethanol production," Berrick says.

But Drost worries that expansion in the ethanol industry will create a glut of distillers' grains. "I'm not bullish on the future of the distillers' grain market," he says. "That is one reason our group has worked so hard to get our feed into new markets like swine."

"The biggest problem in the market right now is that many livestock producers still don't know enough about using the byproduct," says Scott Swanson, general manager of Midwest Grain Processors in Lakota, S.D., which produces 25 million gallons of ethanol and 150,000 tons of distillers' dried grains annually. "Distillers' grain is new enough that producers don't really know how to feed or handle it, or how much to use in rations," he says.

In response, the corn and ethanol industry, universities and groups like the Iowa Beef Center are making an aggressive effort to educate livestock producers on the use of DDGS in rations.

"We're hoping the exposure to how distillers' grains are being used in the livestock market will help stabilize the ethanol market by creating a larger need for both ethanol and distillers' grain," says Jerry Swanson, livestock services manager with the National Corn Growers Association. ■

New technology makes distillers' grains for efficient transport and water use.

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Feeding new generation DDGS to swine

by Terry Stanton, PhD

One of the hottest topics in the feed industry today involves feeding "new generation" dollar's worth grain, with soluble (DDGS) in swine. DDGS is one of the three co-products produced in dry mill ethanol plants along with fuel ethanol and carbon dioxide. The production of DDGS is increasing at a rapid rate due, in part, to many states banning methyl tertiary butyl ether (MTBE) as a gasoline oxygenation agent—increasing ethanol demand. Currently, the fuel ethanol industry in the USA produces about 3.8 billion tons of DDGS. Many ethanol industry experts project that by 2015, the amount will be near 5.5 billion tons.

Although over 80% of DDGS has historically been fed to cattle, in 1999, 2001 and 2007 research by Whitney, Smith and Stanton at the University of Minnesota clearly showed DDGS produced by new generation ethanol plants is why well suited for swine and poultry diets. As a result of this research, the researchers also showed that DDGS can be a cost-effective partial replacement for corn, soybean meal and calcium phosphate in diets for these animals. Depending on the method of denaturation used—total amino acid and phosphorus levels vs. available amino acid and available phosphorus levels—adding 10% DDGS to swine diets will reduce the cost per ton of complete feed by \$0.65-\$1.40 per ton.

Whitney is a professor of poultry nutrition and management at the University of Minnesota. He can be contacted at the university, Department of Animal Science, 2200 Animal Sciences Bldg., 1909 Park Ave., St. Paul, MN 55108 USA, tel +1 612 624 2764, fax +1 612 625 1250, shum001@umn.edu, www.aggip.com.

Some in the industry are beginning to recognize the potential of DDGS. Two years ago estimates indicated that only about 30,000 tons of DDGS were included in swine diets. Currently, swine diets include over 80,000 tons.

What levels?

Currently, most substitution in the feed and pork industries are using up to 5% DDGS in nursery pig diets, up to 10% in grow-finish and lactating diets and up to 20% in gestation diets. Adding new generation DDGS to these inclusion levels provides excellent performance and feed cost savings. However, our research results have shown that new generation DDGS can be fed at levels up to 25% in phase 2 and phase 3 nursery diets, up to 26% in grow-finish and lactation diets and up to 50% in gestation diets and provide satisfactory performance and improved feed cost savings. But, in order to achieve high performance at these high inclusion rates, the DDGS source and nutrient variability must be known, diets must be formulated on a digestible amino acid and available phosphorus basis and DDGS must be free of mycotoxins.

In a previously unpublished 2007 trial, Whitney and Stanton mixed 96 combinations at an average of 10 days of age (7.4 kg), blocked them by gender and ancestry, and put them on one of six dietary treatments. All pigs consumed the same commercial phase 1 nursery diet for the first 4 days after weaning. Pigs were subjected to their respective phase II experimental diets on the fourth day post-weaning, and remained on their diets for 14 days. On the

14th day post-weaning, they changed the pigs' diets to their respective phase III experimental diets, which the pigs ate for the final 21 day feeding period. Diets were formulated to contain equivalent levels of apparent total digestible lysine, L-lysine, amino acids (methionine and cysteine), available energy (ME), calcium, phosphorus, vitamins and trace minerals.

There were no significant differences in gain, feed intake, and feed conversion, regardless of the level of DDGS fed during phase II, phase III, and over the entire 28-day feeding period (see table "DDGS" effect on Nursery pig performance). The exception was that the pigs eating the 10% DDGS diet during phase II grew slower than pigs fed the 20% DDGS diet. These results suggest that up to 25% DDGS can be included in phase



A pig diet that has been formulated from DDGS.



New generation 10% old generation 25%.

DDGS is high in fiber. This high fiber content limits its use in phase I baby pig diets for early weaned pig but it supports excellent performance in phase II and subsequent nursery and grow-finish diet plans, as demonstrated in the nursery pig trial. When swine are already switched to high DDGS diets—gestation diets with up to 50% DDGS and lactation diets with up to 20% DDGS—feed intake often declines for a period of 5-7 days until the swine adjust. This short-term feed acceptance response is often observed when swine are fed high fiber diets. However, when handled in the upper Midwest generally have fewer signs of mycotoxin contamination because they are locally grown corn, which tends to grow in relatively cooler, less humid growing conditions. Despite the potential risk of mycotoxin contamination, there are very few cases of mycotoxins reported from feeding DDGS.

Feeding DDGS to swine

Pig health benefits?

Several pork producers have observed improvements in gut health in herds with recurring problems with diets (acute diarrhea outbreaks) when they added DDGS to finishing diets. Lactosaccharinase, a microorganism bacteria that breaks mucinate epithelial cells located in the crypts of the small intestine, can assist this. The organism is able to interfere with mucinase, so the cells multiply without being sloughed off. The result is that the intestinal wall thickens, thus decreasing leaky gut.

We conducted three disease challenge studies where we included healthy pigs with Lactosaccharinase to study the effects of various dietary treatments—including adding DDGS to the diet at 15 or 20%—on the incidence and severity of enterotoxemia. Conducting disease challenge studies to measure dietary effects on gastrointestinal health is difficult, especially challenging in administering an inoculation dose comparable to field conditions. It appears that there may be some benefits of adding DDGS to diets to improve gut health of pigs when combined with a Lactosaccharinase, but our results have been inconclusive.

In our first study, we greatly exceeded the inoculation dose of Lactosaccharinase and observed no benefits of feeding diets containing 10 or 20% DDGS on reducing the incidence or severity of intestinal lesions caused by diets.

In our second study, we included the pig

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We Created a DDGS Web Site to Serve as a Technical Library of Information on Feeding DDGS to Livestock and Poultry



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The Value and Use of Distillers Dried Grains with Solubles (DDGS) in Livestock and Poultry Feeds

Welcome to the University of Minnesota DDGS Web site!

This site was developed to provide its users a "one stop" place to find all of the most current information related to using DDGS in dairy, beef, swine and poultry feeds.



The ethanol industry is one of the most rapidly growing agricultural industries in the U.S.

Currently, dry mill ethanol plants produce over 3.8 million metric tonnes of DDGS annually.

Industry experts predict that the volume of DDGS produced will increase to over 5.5 million metric tonnes by the year 2005. Because of the large supply of DDGS available to the feed and livestock industry, researchers at several Land Grant Universities have been conducting experiments to evaluate the nutritional value of DDGS in order to develop feeding recommendations for dairy, beef, swine, and poultry. In addition to DDGS research conducted by scientists in the [Department of Animal Science](#) at the University of Minnesota, we are pleased to provide you with research and technical publications from researchers at:

University of Georgia
Kansas State University
University of Nebraska-Lincoln
South Dakota State University

The majority of DDGS produced by ethanol plants in the US today is derived from corn. However, there is also a small but increasing amount of DDGS that is produced from sorghum (milo). The majority of information included on this Web site involves the evaluation of corn DDGS in livestock and poultry feeds. However, we have also included a section for research and technical information specific to sorghum DDGS (see [Other Types of DDGS](#)).

International
Audiences

Key Contacts

Links

General Information
MNEthanol Industry
DDGS Marketing

Other Types
of DDGS

There is considerable variation in DDGS quality, nutrient composition, and nutrient digestibility among sources. Research conducted at the University of Minnesota



has shown that corn DDGS produced by modern, dry mill ethanol plants in Minnesota and South Dakota is of much higher quality and nutritional value for swine and poultry than DDGS produced by older, more traditional ethanol plants. Distiller's dried grains with solubles produced by these "new generation" ethanol plants is an excellent source of energy, digestible amino acids, and available

phosphorus for swine and poultry diets.

Currently, DDGS is an economical, partial replacement for corn, soybean meal, and dicalcium phosphate in livestock and poultry feeds. Historically, over 85% of DDGS has been fed to dairy and beef cattle, and DDGS continues to be an excellent, economical feed ingredient for use in ruminant diets.



Please [email](#) us with your comments.

[Acknowledgments](#).

The University of Minnesota is an equal opportunity educator and employer.

URL: <http://www.ddgs.umn.edu>

Modified 9/11/03 by [Bonnie Rae](#)

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US Grains Council Target Export Markets Are Also Using This Information



Telling the Story...

International Feed Companies and Producer Audiences

- China - 2002
- Japan – 2001, 2002
- Taiwan – 2002, 2003
- Korea – 2003
- SE Asia – 2004

- Mexico – 2003
- Canada – 2003, 2004
- Central & South America – 2002

- Spain – 2003
- Germany - 2003





Japan

- emerging market
- initial interest in dairy rations
- Japan Science Feed Association
 - currently updating nutrient values of samples from 7 “new generation” plants to establish new DDGS nutrient specifications
- conducted a feeding trial with small ruminants
- future use will also focus on swine and poultry



Taiwan

- have been importing containers of DDGS for the past 18 months
- primary interest in swine and poultry diets
- summer feeding trials with growing pigs, broilers, and dairy cows are completed
- currently conducting winter feeding trials this year with growing pigs and broilers
- nutrient values and research information from swine and poultry studies conducted at the University of Minnesota are being used in these trials
- based upon research results from the dairy feeding trial, 20 commercial dairy herds are now using DDGS



South Korea

- potential DDGS market
- significant interest in importing DDGS
- has not been a target market for USGC
- primary use would be for swine & poultry



Southeast Asia

- Malaysia has started importing containers of DDGS during the past 6 months
- relatively small DDGS market
- high interest in importing DDGS
- used primarily in swine & poultry feed

Canada



- existing DDGS market with huge potential for increased DDGS exports
 - large livestock and poultry industry
 - relatively close to upper Midwest ethanol plants
- currently produces 200 million liters of ethanol/year
- U.S. produces about 7 billion liters/year
- Canada ethanol industry is starting to grow
 - feeding trials are being planned for 2005
 - both corn and wheat DDGS will be produced



Europe

- has historically been the primary DDGS export market
- approximately 770,000 tons of DDGS are exported annually
- considerable interest in conducting swine feeding trials in Spain

Challenges for Marketing YOUR Distiller's By-Products Now and in the Future

- Who will evaluate new distiller's by-products?
- Who will educate prospective customers on how to use distiller's by-products effectively?
- Who will fund the research?



Current DDGS Swine Research Projects at the U of M

- **Impact of feeding DDGS on pre-harvest food safety (Salmonella)**
 - Mindy Spiehs, PhD candidate
- **Spray-dried distiller's solubles fractions in baby pig diets**
 - Jeff Knott, PhD candidate
- **Impact of adding DDGS and phytase on manure P content and chemical forms of P**
 - Mark Whitney, PhD
- **Correlation between DDGS color, ADICP, and true amino acid digestibility in poultry**
- **Nutrient profiles of DDGS from various Midwestern ethanol plants**
- **Stability and preservation of DDGS in various climates**

