

# Feeding Bioenergy Coproducts to Swine

## Distillers Dried Grains with Solubles (DDGS)

Iowa is a leader in both corn production and the milling of corn into ethanol. As of April 2007, Iowa had 23 corn ethanol plants and 20 more plants in construction and planning stages. In 2006, approximately 650 million bushels of Iowa corn was milled by corn ethanol plants.

The primary coproduct of dry-milling ethanol plants is distillers dried grains with solubles (DDGS). In Iowa, the primary grain used is corn that is fermented and alcohol is collected by distillation. Through the fermentation process, much of the starch in corn is removed and the remaining corn nutrients are concentrated in the coproduct. The remaining coproduct is DDGS, which is an excellent feed for many species including swine.

### Composition and quality of DDGS

DDGS from new ethanol plants has improved nutrient composition from that of traditional distillers. A Minnesota survey of six corn ethanol plants in Iowa showed excellent nutrient composition for DDGS. These plants started production after January 2002 and typically produce higher quality DDGS than older facilities. DDGS values from Iowa plants are comparable with those from other new corn ethanol plants in the Midwest and across the United States.

**Table 1. Nutrient composition of DDGS from new Iowa corn ethanol plants compared with corn (as-fed basis).**

|                               | DDGS <sup>a</sup>  | Corn <sup>b</sup> | Ratio <sup>d</sup> |
|-------------------------------|--------------------|-------------------|--------------------|
| Dry matter, %                 | 89                 | 89                | 100                |
| Metabolizable energy, kcal/lb | 1,550              | 1,555             | 100                |
| Crude protein, %              | 27.99              | 8.30              | 337                |
| Lysine, %                     | 0.82               | 0.26              | 315                |
| Methionine, %                 | 0.54               | 0.17              | 320                |
| Threonine, %                  | 1.02               | 0.29              | 350                |
| Acid detergent fiber, %       | 12.80 <sup>c</sup> | 2.80              | 457                |
| Fat, %                        | 8.92               | 3.90              | 227                |
| Calcium, %                    | 0.07               | 0.03              | 237                |
| Phosphorus, %                 | 0.64               | 0.28              | 229                |

<sup>a</sup>Survey results of six ethanol plants in Iowa beginning production after January 2002 converted to as-fed basis. (University of Minnesota, 2006).

<sup>b</sup>NRC, 1998.

<sup>c</sup>Data from five plants.

<sup>d</sup>DDGS ÷ Corn values x 100

Table 1 shows that DDGS has a similar dry matter and energy value to corn grain and that most of the other DDGS nutrients are 2 to 3.5 times the concentration of corn.

High quality DDGS should be golden yellow in color. In contrast, DDGS that is dark colored or smells burnt is lower quality and will have lower nutrient composition and availability and should be avoided in swine diets. The best way to accurately formulate swine diets using DDGS is to sample each load of coproduct for nutrient composition.

### Use in swine diets

Most nutritionists suggest using up to 20% DDGS in nursery, grow-finish, and lactating sow diets. Diets for gestating sows and boars can utilize up to 40% DDGS.

A simple substitution rate of 10% DDGS in a corn-soybean meal swine grower diet is 200 lb DDGS and 3 lb calcium carbonate for 177 lb of corn, 20 lb of soybean meal (47.5% CP), and 6 lb of dicalcium phosphate (18.5% P) per ton of complete feed. This substitution is based on available lysine and phosphorus values.

### Advantages

- DDGS will become increasingly available in Iowa as more ethanol plants are built.
- DDGS has 2 to 3.5 times more amino acids, fat, and minerals as corn.
- DDGS has highly available phosphorus, which allows reduction of other phosphorus sources in the diet.
- The health of the pig's intestine, or gut, may be improved by feeding DDGS and adverse effects of gut diseases, e.g. ileitis, may be reduced.
- The increased fiber in DDGS may be beneficial for gestating sows.

### Disadvantages

- The nutrient content of DDGS can vary from plant to plant and from day to day at the same plant.
- DDGS has a high fiber content, which, if fed at high inclusion levels, may be a negative in early-weaned pig diets.
- The production of DDGS will concentrate mycotoxins present in corn.
- At diet levels above 20% DDGS, the increased corn oil can produce a softer, oilier fat in pigs.
- DDGS may not flow readily out of hopper bins or trucks.

## Variability

DDGS will vary in nutrient composition and quality based on the drying equipment and techniques, corn grain quality, and the final mix of wet distillers grain with distillers liquid solubles at the plant. Exact DDGS composition can vary from plant to plant and from day to day at the same plant. Sampling each load is the best way to know its exact composition.

## Mycotoxins

Swine can be very sensitive to mycotoxins, and because the fermentation and drying process does not deactivate mycotoxins in corn or DDGS, producers should be aware of potential mycotoxins in DDGS. This is especially important because mycotoxins in corn are concentrated about threefold during the ethanol production process. The bottom line is that you need to know your DDGS source and that the complete diet mycotoxin level is the key value.

**Corn with 1 ppm mycotoxin will produce DDGS with 3 ppm mycotoxin.**

### Examples:

1. Using corn with 1ppm mycotoxin:  
A corn-soy diet that is 80% corn will have 0.8 ppm mycotoxin level.
2. Using corn with 1 ppm mycotoxin and the resulting DDGS:  
A corn-soy-DDGS diet with 70% corn and 10% DDGS will have a 1.0 ppm mycotoxin level if both corn and DDGS with mycotoxin are used. A corn-soy-DDGS diet with 70% corn and 10% DDGS will have a 0.3 ppm mycotoxin level if only the DDGS with mycotoxin is used.

## Nutrient availability of DDGS

The bioavailability of the amino acids and phosphorus in DDGS to swine is good. Lysine availability in DDGS is approximately 53% and phosphorus availability is approximately 86 to 90%. The phosphorus availability in DDGS is much higher than from corn (15%) or soybean meal (23%). Therefore, the available lysine value for DDGS is 0.43% (0.82 x 53%) and the available phosphorus value for DDGS is 0.55% (0.64 x 86%).

Because of the higher phosphorus availability of DDGS, diets using this feedstuff should be formulated on an available phosphorus basis which will result in lower levels of supplemental phosphorus. Because phosphorus is most commonly added to swine diets as dicalcium phosphate, reducing the inclusion rate of dicalcium phosphate in the diet lowers both phosphorus and calcium level of the diet and may provide economic and environmental benefits.

However, one must still maintain appropriate calcium levels in diets containing DDGS such that calcium carbonate may need to be added.

## Strategies

- Test for nutrient content and mycotoxins regularly. The best approach is to know your supplier and to test each load.
- Remember that complete diet mycotoxin level is the key value.
- Start with a low inclusion rate (5%) and work up to a higher inclusion rate (20%).
- Formulate diets to make the best use of DDGS advantages – phosphorus and amino acids – while maintaining levels of other nutrients such as calcium.
- Calculate tradeoff based on current prices of DDGS, corn, soybean meal, and dicalcium phosphate in your locale.

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