Feeding bioenergy coproducts to swine

by Professor Mark Honeyman and Peter Lammers, research assistant, Animal Science Department, and Sherry Hoyer, Iowa Pork Industry Center, Iowa State University, USA.

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.

Advantages

- DDGS will become increasingly available in Iowa as more ethanol plants are built.
- DDGS has 2.0-3.5 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, for example, ileitis, may be reduced.
- The increased fibre 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 fibre 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.

Composition and quality

DDGS from new ethanol plants has improved nutrient composition from that of traditional distillers which was shown in a Minnesota survey of six corn ethanol plants in Iowa.

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 USA.

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 2.0-3.5 times the concentration of corn.

High quality DDGS should be golden yellow in colour. In contrast, DDGS that is dark coloured or smells burnt is lower quality and will have lower nutrient composition and availability and should be avoided in pig 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 utilise up to 40% DDGS.

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

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.

	DDGS[a]	Corn[b]	Ratio[d]
Dry matter (%)	89	89	100
Metabolisable 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 fibre (%)	12.80[c]	2.80	457
Fat (%)	8.92	3.90	227
Calcium (%)	0.07	0.03	237
Phosphorus (%)	0.64	0.28	229

[a] Survey results of six ethanol plants in Iowa beginning production after January 2002 converted to as-fed basis (University of Minnesota 2006). [b] NRC, 1998. [c] Data from five plants.
[d] DDGS + corn values x 100.

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

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.

Nutrient availability

The bioavailability of amino acids and phosphorus in DDGS to swine is good. Lysine availability in DDGS is approximately 53% and phosphorus availability is approximately 86-90%. The phosphorus availability in DDGS is much higher than from corn (15%) or soybean meal (23%).

Therefore, the available lysine value from 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 trade off based on current prices of DDGS, corn, soybean meal and dicalcium phosphate in your area. ■