
Sponsors

University of Minnesota

College of Veterinary Medicine

College of Food, Agricultural and Natural Resource Sciences

Extension Service

Swine Center

Thank you to **IDEXX Laboratories** for their financial support to reproduce the conference proceeding book.

Production Leader

Steven Claas

Production Assistant

Steven Claas

Janice Storebo

Sarah Summerbell

Layout and CD-ROM

David Brown

Tina Smith

Logo Design

Ruth Cronje, and Jan Swanson;

based on the original design by Dr. Robert Dunlop

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, or sexual orientation.

Dealing with high corn prices

J.E. Pettigrew

University of Illinois, Department of Animal Science, Urbana, IL

The diversion of startling amounts of corn from the food chain to ethanol production is the most powerful change now underway in U.S. agriculture. Perhaps the most unfortunate result of that diversion in the long term is the impact on the world's food supply. As the world's human population has doubled during the last few decades, our food production system has quite impressively kept up with the increasing demand for food, and we now actually produce more food per person than we did 40 years ago. That critical accomplishment was achieved by focusing enormous amounts of resources, work and ingenuity on increasing food production from limited natural resources. The population growth rate has diminished when expressed as percent per year, but we will still add as many people to the world during the next 40 years as during the last 40. And there's another factor. The exhilarating improvement in living standards in much of the developing world means many more people can now improve their diets by adding animal products to them, and that reduces the overall efficiency of food production. Therefore, our challenge in producing enough food may be as daunting – or more so – during the next few decades as during the last few. In that context, the diversion of massive amounts of material from the food chain will presumably prevent multitudes of people from obtaining the improved diets that would otherwise have been possible.

While the most important long-term impact of ethanol production may be on food availability to people with limited resources, the most acute immediate impacts may be on livestock producers, whose feed costs are skyrocketing. The purpose of this paper is to discuss useful responses of pork producers to high prices of corn.

There are two principal ways pork producers can ameliorate the impact of high corn prices:

- Use of alternative feed ingredients
- Improvement of feed efficiency

Alternative ingredients

DDGS

Ethanol production caused much of the rise in corn prices, and ethanol production can be part of the solution. Most ethanol production from corn produces distillers dried

grains with solubles (DDGS) as a co-product that is useful as a feed ingredient. While DDGS is inherently more suited for ruminant animals, it can be fed to pigs very successfully.

About two thirds of corn is starch, and most of that starch is fermented to produce ethanol. Therefore, the remaining material (DDGS) contains the other components of corn concentrated by about three-fold. It contains some residual yeast from the fermentation, but that yeast does not substantially alter the composition of DDGS from the rule of a three-fold concentration of the non-starch components of corn.

The chief nutritional characteristics of DDGS are:

- Digestible energy level about equal to that of corn, but with lower net energy level
- High fat level (typically about 10%); highly polyunsaturated fat
- High fiber level (typically about 25% neutral detergent fiber [NDF] and 10% acid detergent fiber [ADF]); fiber is almost all insoluble and poorly fermentable
- Medium protein level (typically about 25 – 30%); poor protein quality, especially low in lysine and tryptophan (as is corn); poor and variable amino acid digestible (especially of lysine)

Perhaps the most difficult characteristic to manage is the variation in quality, especially in levels of digestible lysine. I am optimistic that the quality will gradually become more consistent with time, but we need methods for managing this variation now. With present information, I suggest the following:

- Buy DDGS from only one or a few plants in which you have developed confidence
- Buy only light-colored DDGS
- Buy only DDGS in which lysine is at least 2.8% of crude protein
- Avoid DDGS with a high level of “syrup balls” (based on conjecture at this point)

The available data about the impact of DDGS in the diet of finishing pigs on their performance is mixed. Some studies show a progressive reduction in growth rate as DDGS level increases, while others show no effect of levels as

high as 30% of the diet on growth rate. The difference in response appears not to be due to overestimation of the nutrient contributions of DDGS in those cases in which performance was reduced. It is not clear whether palatability may be involved.

There are physical characteristics of DDGS that deserve consideration. Its high levels of fat and fiber cause it to have a steep angle of repose, meaning that it (and diets containing high levels) does not feed down well in bulk bins and feeders. It has a low bulk density, so a bin that normally holds 8 tons of feed will hold only 7.6 tons of a diet containing 20% DDGS.

Carcass fat of pigs tends toward the fatty acid composition and physical characteristics of the pigs' dietary fat. We have known for a long time that feeding high levels of unsaturated fats causes pork carcass fat to be soft, and that is detrimental for processing. Predictably, inclusion of high levels of DDGS in diets of finishing pigs causes carcass fat to be softer. Whether that becomes a problem depends on the level of DDGS, the time of feeding it, and the standards of the packer (usually measured as iodine value of the carcass fat). As an industry, we have not yet adequately defined the feeding programs that will maximize use of DDGS while producing acceptable carcass quality. As a practical recommendation, I suggest limiting the amount of DDGS or eliminating it from diets during the final weeks of finishing.

Some in the industry have suggested, based on practical experience that DDGS helps to protect pigs from ileitis. A series of experiments in which pigs were challenged with *Lawsonia intracellularis* failed to show clinical benefits of DDGS (e.g. Whitney et al., 2006), but the notion persists in the industry. My laboratory is now engaged in investigations of potential protection against enteric disease from feeding DDGS.

Dr. Hans Stein at the University of Illinois has published the recommendations for maximum use levels of DDGS shown in **Table 1**. While recognizing that higher levels have been fed successfully in practical pig production, I agree with the recommendations in **Table 1** except for the level used in late finishing, which I believe should be lower.

The technology of ethanol production from corn is in an early stage. As it develops, there will likely be changes in processing methods that will change the nature of the co-products available for use in pig feeds, so don't expect the best way to use these ingredients to remain static.

Other commodities

Other commodities can substitute wholly or partially for corn in pig diets. Most of the good candidates are other cereals (sorghum, barley, wheat), but others such as peas may also be considered. They are used widely in pig feeds outside the Corn Belt. Feeding recommendations for such commodities are widely known and beyond the domain of this paper.

Table 1: Recommended use levels of DDGS in swine diets^A

| Stage of Reproduction | Recommended Use Level (% of diet) |
|-----------------------|-----------------------------------|
| Gestation | 40 |
| Lactation | 20 |
| Early nursery | 0 |
| Late nursery | 20 |
| Growing | 20 |
| Early finishing | 20 |
| Late finishing | 20 |

^AFrom Stein et al., 2007

The key problem with these commodities is that their prices tend to follow corn prices. However, high corn prices may broaden the geographic area in which these commodities are competitive, and careful attention to markets may reveal occasional short-term bargains in any location.

“Waste” materials

A number of materials that emerge from the food and other industries may be captured as nutrient sources for pigs. Such products may fall out of the target product stream for any of several reasons. Some may be processing waste, some fail to meet product specifications, some may have faulty packaging or labeling, some may have passed an expiration date, and there are likely other reasons as well. In most cases a nutritionist is needed to evaluate these materials and gain full benefit of them. Some such materials may need special consideration to ensure against excessive levels of pathogens, microbial growth, toxins or oxidation, or poor palatability. Some may be variable in nutrient content. Some require special handling because of product consistency or packaging. However, some may significantly reduce feed costs.

Bakery waste and cookie meal are two examples of such products that are often used in pig diets. Dried whey and animal-vegetable fat blends are such products that have reached the status of commodity ingredients. Other examples include milk chocolate product and cheese products. Attention has recently been directed to the use of pet foods in pig diets. After the attention caused by melamine contamination of these products, they may be unusually safe now.

Of special interest are liquid materials that emerge from the food industry. They may be provided to pigs in either of two ways. First, some of them may be provided as a water source, through drinking water lines. Such an approach requires attention to ensure water is not restricted relative to intake of other nutrients. It also requires consideration of the nutrient intake from these products in formulation of the dry diet in order to gain maximum benefit. A number of liquid products are available for such use.

The other way to use liquid products is in a sophisticated liquid feeding system. Such systems have been quite popular and successful in Europe for many years, and more recently in Ontario. They require significant investment in the necessary hardware and software, but they allow fine control of nutrient delivery to pigs and they allow the use of inexpensive liquid nutrient sources. ***I believe the U.S. swine industry is missing very important opportunities for reducing feed costs by failing to adopt liquid feeding systems. I strongly encourage investigation of these opportunities.***

Improving feed efficiency

There is nothing new here. We all know what needs to be done. This is just another tiresome encouragement to invest the hard work required to do everything consistently well – every day! That hard work can yield bigger benefits when the feed you save costs more than the historical standards, as it does now.

The following is a short list of reminders of issues that deserve attention:

- Feeder adjustment: Easy to recommend, harder to manage consistently
- Feed particle size: The advantages of reducing particle size to a geometric mean particle size of about 700 microns are well recognized by the industry
- Pelleting: Pelleting improves both feed efficiency and growth rate by about 6%. That 6% improvement in feed efficiency is worth more when feed is expensive, so pelleting is economically justified in more situations now than it was two years ago. Some practical experience suggests that in some situations pelleting may make pigs more susceptible to enteric disease.
- Market weight: Marketing at lighter weight will improve feed efficiency. Of course, the economics of market weight are complex and dominated by packer buying policies
- Health Innovations: Investments in improving herd health are likely to be even more rewarding when feed is more expensive. You are the experts!

- Thermal environment: Both heat and cold increase the body's energy demand, so managing buildings to minimize thermal stresses can save expensive feed
- Feed additive: Anything that improves feed efficiency is more valuable when feed prices are high. That improves the economic balance of using everything from Paylean to enzymes.

Summary

High corn prices may change some of the decisions we make in pig production. I suggest appropriate responses to high corn prices are in two areas:

- First, we should consider alternative nutrient sources. Distillers dried grains with solubles (DDGS) deserves the most attention because of the enormous increase in its production. I have provided an overview of this product and its appropriate use in pig diets. Other commodities should be considered, but their prices usually increase along with the corn price. I encourage the industry to explore the use of “waste” materials from the food and other industries, with a special focus on liquid products.
- Second, we should renew our focus on improving feed efficiency. I offer no new approaches but provide reminders of important issues that deserve attention.

References

- Stein, H.H. 2007. Distillers dried grains with solubles (DDGS) in diets fed to swine. Swine Focus #001, Department of Animal Sciences, College of ACES, The University of Illinois at Urbana-Champaign.
- Whitney, M.H., G.C. Shurson, and R.C. Guedes. 2006. Effect of dietary inclusion of distillers dried grains with solubles on the ability of growing pigs to resist a *Lawsonia intracellularis* challenge. *J. Anim. Sci.* 84:1860-1869.

