# EFFECTS OF DISTILLERS GRAINS ON GROWTH PERFORMANCE IN NURSERY AND FINISHING PIGS

***B. W. Senne, J. D. Hancock, P. S. Sorrell, I. H. Kim, S. L. Traylor[1], R. H. Hines, and K. C. Behnke[1]***

## Summary

Rate and efficiency of gain were not affected by adding as much as 20% distillers dried grains in isocaloric diets for nursery pigs or 30% in isocaloric diets for finishing pigs. These results demonstrate that the previously suggested maximums of 5% distillers dried grains in nursery diets and 10% distillers dried grains in finishing diets are too conservative. Finally, because the 20% (nursery) and 30% (finishing) treatments were the greatest concentrations used in our experiments, additional growth assays are needed to determine the maximum limits for distillers dried grains in diets for pigs.

(Key Words: Distillers Grains, Nursery, Finishing, Sorghum.)

## Introduction

Distillers dried grains with solubles (DDGS) result from the fermentation of cereal grains to produce ethyl alcohol. After the alcohol has been removed, the residue is dried to yield DDGS as a source of energy and protein for animal diets.

With the current interest in production of ethanol for fuel/industrial uses, it seems likely that greater quantities will soon become available. However, little information is available about use of DDGS in pig diets, and most of that information was generated 15 to 25 years ago with corn used in the distillation process. Thus, we designed experiments to evaluate sorghum-based DDGS in diets for nursery and finishing pigs.

## Procedures

A total of 72 nursery pigs (average initial wt of 15 lb) was used in the first experiment. There were six pigs per pen and four pens per treatment (two pens of barrows and two pens of gilts per treatment). For 7 d post-weaning, all pigs were fed the same complex starter diet ( pelleted form) to allow time for adjustment to the nursery environment. On d 7, the pigs were changed to the experimental diets: 1) corn-soybean meal-based control; 2) 10% DDGS; and 3) 20% DDGS. All diets were formulated to 1.4% lysine, .9% Ca, and .8% P and fed in meal form (Table 1). The ME in the diets was adjusted to the same concentration by adding soybean oil.

The experiment was conducted in an environmentally controlled nursery room equipped with 4-ft × 5-ft pens. Each pen had a self-feeder and nipple waterer to provide ad libitum access to feed and water. The pigs and feeders were weighed on d 7 and 29 to determine ADG, ADFI, and F/G. The data were analyzed as a randomized complete block design with initial weight as the blocking criterion. Day 7 was used as a covariable for analysis of the d 7 to 29 growth data. Polynomial regression was used to characterize the shape of the response to increased concentration of DDGS in the diets.

[1]Department of Grain Science and Industry.

In the second experiment, 192 hybrid (PIC line 326 boars × C15 sows) barrows and gilts were used. The average initial weight was 94 lb, and the average final weight was 192 lb. The pigs were allotted by weight into 16 pens (6 ft × 16 ft) with 12 pigs per pen and four pens per treatment. Treatments were: 1) corn-soybean meal-based control; 2) 10% DDGS; 3) 20% DDGS; and 4) 30% DDGS. All diets were formulated to .9% lysine, .65% Ca, and .55% P and fed in meal form (Table 2). As in the nursery experiment, soybean oil was used to ensure that all diets had the same concentration of ME.

Weights were taken at the beginning and end of the 49-d experiment to determine ADG, ADF, and F/G.

The data were analyzed as a randomized complete block design with initial weight as the blocking criterion. Polynomial regression was used to describe the shape of the response to increasing concentration of DDGS in the diets.

## Results and Discussion

Chemical analysis of ingredients (Table 3) indicated that the compositions of corn and sorghum were similar to one another and published values (e.g., NRC, 1988). However, the fermentation of starch to ethanol greatly concentrated the nonstarch components (e.g., protein, fat, fiber, ash, and amino acids) in the DDGS. Thus, we might anticipate a lower energy value in DDGS (from less starch) despite the high gross energy (i.e., 4.47 for DDGS versus 4.09 and 4.00 for the sorghum and corn, respectively).

For the experiment with nursery pigs (Table 4), ADG, ADFI, and F/G were not affected by increasing the concentration of DDGS up to 20% of the diet (P>.17). This observation is in sharp contrast with the generally accepted maximum inclusion of only 5% DDGS in diets for nursery pigs. The chemical changes during the distillation process did yield a product with lower energy value. Previous results from a chick assay conducted in our laboratory suggested that the published ME value for DDGS (1,513 kcal/lb) in the NRC (1988) are too high. Our chick assay suggested that a more realistic ME value would be 1,176 kcal/lb. Thus, the discrepancies among our results (with soy oil used to equalize ME) and other reports are likely due to no attempt to equalize ME or use of excessively high values for the ME concentration in DDGS when the diets for the earlier experiments were formulated.

For the experiment with finishing pigs (Table 5), ADG, ADFI, and F/G were not affected by increasing the concentration of DDGS up to 30% of the diet (P>.13). Like the nursery experiment, diets for the finishing experiment were adjusted to the same ME concentration by adding soybean oil. The similar ADFI and F/G for all diets suggested similar ME concentrations, and although pig experiments are needed to determine the actual ME concentration of sorghum-based DDGS, the values we used for our experiments (determined in a chick assay) were fairly accurate. Finally, our results suggested that concerns about palatability of diets with DDGS are unwarranted.

In conclusion, DDGS can be used at concentrations of at least three to four times greater than previously suggested without adversely affecting growth performance of nursery and finishing pigs when ME is equalized with fat. Although additional experiments are needed to determine the maximum amount that can be added to diets for pigs, nutritionists certainly should not feel constrained to less than 20% DDGS for nursery diets and 30% DDGS in diets for finishing pigs.

**Table 1. Diet Composition for the Nursery Experiment, %[a]**

| | | Dried distillers grains with solubles | |
|---|---|---|---|
| Ingredient | Control | 10% | 20% |
| Corn | 47.06 | 36.20 | 25.33 |
| Soybean meal (46.5% CP) | 30.84 | 29.78 | 28.73 |
| Dried whey | 15.00 | 15.00 | 15.00 |
| Dried distillers grains | — | 10.00 | 20.00 |
| Lysine -HCl | .15 | .15 | .15 |
| Methionine | .04 | 0.03 | .01 |
| Fish meal | 2.00 | 2.00 | 2.00 |
| Soybean oil | 1.00 | 3.03 | 5.05 |
| Monocalcium phosphate | 1.41 | 1.27 | 1.14 |
| Limestone | .65 | .70 | .75 |
| Vitamin premix | .25 | .25 | .25 |
| Trace mineral premix | .15 | .15 | .15 |
| Salt | .20 | .20 | .20 |
| Zinc oxide | .25 | .25 | .25 |
| Antibiotic[b] | 1.00 | 1.00 | 1.00 |

[a]All diets were formulated to 1.4% lysine, .9% Ca, .8% P, and 1,476 kcal ME/lb of diet. [b]Supplied 50 g/ton of carbadox.

**Table 2. Diet Composition for the Finishing Experiment, %[a]**

| | | Dried distillers grains with solubles | | |
|---|---|---|---|---|
| Ingredient | Control | 10% | 20% | 30% |
| Corn | 77.68 | 66.82 | 55.95 | 45.08 |
| Soybean meal (46.5%) | 19.52 | 18.46 | 17.41 | 16.35 |
| Dried distillers grains | — | 10.00 | 20.00 | 30.00 |
| Lysine -HCl | .15 | .15 | .15 | .15 |
| Soybean oil | — | 2.01 | 4.02 | 6.04 |
| Monocalcium phosphate | .97 | .84 | .70 | .56 |
| Limestone | 1.03 | 1.07 | 1.12 | 1.17 |
| Salt | .30 | .30 | .30 | .30 |
| Vitamin premix | .15 | .15 | .15 | .15 |
| Trace mineral premix | .10 | .10 | .10 | .10 |
| Antibiotic[b] | .10 | .10 | .10 | .10 |

[a]All diets were formulated to .9% lysine, .65% Ca, .55% P, and 1,496 kcal/lb of ME.
[b]Supplied 50 g/ton of carbadox.

**Table 3. Composition of Corn, Sorghum, and Sorghum-Based Distillers Dried Grains with Solubles**

| Ingredient | Corn | Sorghum | DDGS |
|---|---|---|---|
| DM, % | 91.9 | 91.9 | 89.8 |
| CP, %[a] | 8.0 | 9.5 | 25.3 |
| Ether extract, %[a] | 3.9 | 3.0 | 8.1 |
| Crude fiber, %[a] | 3.2 | 2.5 | 9.6 |
| Ash, %[a] | 1.3 | 1.3 | 4.5 |
| GE, Mcal/kg[a] | 4.00 | 4.09 | 4.47 |
| ME, Kcal/lb | 1,551[b] | 1,488[b] | 1,176[c] |
| Amino acids, %[a] | | | |
| Arginine | .42 | .32 | .94 |
| Histidine | .26 | .21 | .56 |
| Isoleucine | .30 | .34 | .94 |
| Leucine | .97 | 1.03 | 2.41 |
| Lysine | .29 | .23 | .58 |
| Methionine + cystine | .42 | .34 | .97 |
| Phenylalanine + tyrosine | .66 | .68 | 1.87 |
| Threonine | .28 | .26 | .81 |
| Tryptophan | .06 | .08 | .20 |
| Valine | .41 | .43 | 1.21 |

[a]Dry matter basis.
[b]From NRC (1988).
[c]Determined in our laboratory via chick bioassays.

**Table 4. Effects of Sorghum-Based Dried Distillers Grains with Solubles on Growth Performance of Nursery Pigs[a,b]**

| | | Dried distillers grains with solubles | | | Contrasts[c] | |
|---|---|---|---|---|---|---|
| Item | Control | 10% | 20% | CV | Linear | Quadratic |
| ADG, lb | 1.02 | 1.06 | 1.01 | 5.4 | -- | -- |
| ADFI, lb | 1.64 | 1.71 | 1.76 | 6.5 | -- | -- |
| F/G | 1.61 | 1.61 | 1.74 | 6.9 | -- | -- |

[a]A total of 72 weanling pigs (six pigs per pen and four pens per treatment) with an avg initial wt of 15 lb and an avg final wt of 40 lb.
[b]The experimental diets were fed from d 7 to 29 of the nursery phase.
[c]Dashes indicate P>.15.

**Table 5. Effects of Sorghum-Based Dried Distillers Grains with Solubles on Growth Performance of Finishing Pigs[a,b]**

| | | Dried distillers grains with solubles | | | | Contrasts[c] | | |
|---|---|---|---|---|---|---|---|---|
| Item | Control | 10% | 20% | 30% | CV | Linear | Quadratic | Cubic |
| ADG, lb | 1.97 | 1.98 | 1.93 | 1.93 | 2.6 | -- | -- | -- |
| ADFI, lb | 5.22 | 5.19 | 4.98 | 5.08 | 3.4 | .14 | -- | -- |
| F/G | 2.64 | 2.62 | 2.58 | 2.63 | 3.9 | -- | .13 | -- |

[a]A total of 192 pigs (12 pigs per pen and four pens per treatment) with an avg initial wt of 94 lb and avg final wt of 192 lb.
[b]The experimental diets were fed for 49 d.
[c]Dashes indicate P>.15.