# USE OF DRIED DISTILLERS GRAINS WITH SOLUBLES AND SOYBEAN HULLS IN NURSERY PIG DIETS

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## Summary

A total of 3,186 pigs were used in two 21-d experiments to evaluate growth performance of nursery pigs fed different levels of dried distillers grains with soluble (DDGS) or soybean hulls. In each experiment, pigs (n = 1,593, and 24.0 lb in Exp. 1 and n = 1,593, and 27.3 lb in Exp. 2) were allotted to 72 pens (36 pens of barrows and 36 pens of gilts) with 21 or 22 pigs per pen on d 21 after weaning. A pen of barrows and pen of gilts shared a common feeder; thus, feeder was the experimental unit. In Exp. 1, treatments were a corn-soybean meal-based control diet or the same diet with 7.5, 15, or 22.5% added DDGS. Increasing DDGS from 0 to 22.5% did not affect ADG ($P > 0.26$) or ADFI ($P > 0.21$) but linearly ($P < 0.004$) improved F/G. The survival rate of pigs (99.0 to 99.5%) was not affected ($P > 0.60$) by diet. In Exp. 2, treatments were arranged as a 2 × 2 factorial with either 0 or 15% DDGS and 0 or 4% soybean hulls. Adding DDGS, soybean hulls, or the combination of DDGS and soybean hulls to the control diet did not affect ($P > 0.17$) ADG. There was an interaction ($P < 0.01$) between DDGS and soybean hulls for ADFI and a trend for an interaction ($P < 0.09$) for F/G. Adding DDGS reduced ADFI and improved ($P < 0.04$) F/G to a greater extent when added to the control diet than when added to the diet containing soybean hulls. Adding soybean hulls to the control diet did not affect ($P > 0.17$) pig performance. The survival rate of pigs (99.5 to 100%) was not affected ($P > 0.31$) by treatments. In summary, 15 to 22.5% DDGS and up to 4% soybean hulls were added to diets for 25- to 50-lb pigs without affecting ADG; increasing levels of DDGS (up to 22.5%) improved feed efficiency in these experiments.

Key words: dried distillers grains with solubles, nursery pig, soybean hulls

## Introduction

In the last few years, the utilization of cereal grains to produce ethanol has rapidly increased in the United States. Because of its abundance, higher starch content, and greater ethanol yield compared with other cereal grains, corn is the most common grain used to produce ethanol. One of the most relevant coproducts obtained from ethanol production is dried distillers grains with solubles (DDGS), and great interest has been generated regarding the use of this coproduct in swine diets. Another by-product that has been studied for use in swine diets is soybean hulls, which originate from soybean processing. The United States is one of world's largest producers of soybeans, with more than 70 million tons produced in 2007. The hulls represent 7 to 8% of the weight of the soybean;

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therefore, approximately 6 million tons of soybean hulls are produced every year. Recent research has indicated that low levels (2 to 4%) of soybean hulls may be added to nursery diets without reducing pig performance. Because soybean hulls are normally less expensive than corn, use at these low levels could reduce diet cost. Limited data is available to determine the influence of soybean hulls on pig performance in commercial farms. Thus, these trials were conducted to evaluate growth performance of nursery pigs fed different levels of DDGS or soybean hulls in a commercial nursery.

## Procedures

Procedures used in these experiments were approved by the Kansas State University Institutional Animal Care and Use Committee. A total of 3,186 pigs were used in two 21-d experiments. In each experiment, 1,593 pigs were allotted to 72 pens (36 pens of barrows and 36 pens of gilts) with 21 or 22 pigs per pen on d 21 after weaning. A pen of barrows and pen of gilts shared a common feeder; thus, feeder was the experimental unit.

**Experiment 1.** Pigs (initially 24.0 lb) were randomly allotted to 1 of 4 dietary treatments. Treatments consisted of a corn-soybean meal-based control diet or the same diet with 7.5, 15, or 22.5% added DDGS (Table 1). On d 21, 28, 35, and 42 after weaning, pigs were weighed and feed disappearance was measured to calculate ADG, ADFI, and F/G. Survival rate was calculated for each feeder by dividing the number of pigs at the end of the experiment by the initial number of pigs (2 pens per feeder; initially 22 pigs per pen). Data were analyzed by using the PROC MIXED procedure in SAS. Contrasts were used to test for linear and quadratic responses to DDGS level.

**Experiment 2.** Pigs (initially 27.3 lb) were randomly allotted to 1 of 4 dietary treatments. Diets were corn-soybean meal-based. Dietary treatments were arranged as a 2 × 2 factorial with either 0 or 15% DDGS and 0 or 4% soybean hulls (Table 2). The experimental procedures followed the same methodology as described for Exp. 1. Data were analyzed by using PROC MIXED in SAS as a randomized complete block design with pens (one barrow pen and one gilt pen) consuming feed from a single feeder as the experimental unit. Data were analyzed for interactions and the main effects of DDGS and soybean hulls.

## Results and Discussion

**Experiment 1.** Increasing DDGS in the diet from 0 to 22.5% did not influence ($P > 0.21$) ADG or ADFI (Table 3). However, increasing DDGS in the diet from 0 to 22.5% linearly ($P < 0.004$) improved F/G. Survival rate of pigs was not affected ($P > 0.60$) by dietary treatment.

**Experiment 2.** Adding DDGS, soybean hulls, or the combination of DDGS and soybean hulls to the control diet did not influence ($P > 0.09$) ADG (Table 4). An interaction ($P < 0.01$) was observed between DDGS and soybean hulls for ADFI. Feed intake was reduced to a greater extent when DDGS was added to the control diet than when added to the diet containing soybean hulls. There was also a trend for an interaction ($P < 0.09$) between DDGS and soy hulls for F/G. Adding DDGS to the control diet improved F/G, whereas adding DDGS to the diet containing soy hulls had no influence on F/G. Adding soybean hulls to the control diet did not influence pig performance. Survival rate of pigs (99.5 to 100%) was not affected ($P > 0.31$) by the treatments.

In conclusion, 15 to 22.5% DDGS and 4% soybean hulls were added to diets for 25- to 50-lb pigs without negatively affecting ADG. Increasing DDGS (up to 22.5%) improved feed efficiency in these experiments.

**Table 1. Diet composition (Exp. 1)**

| | Dried distillers grains with solubles, % | | | |
|---|---|---|---|---|
| Ingredient, % | 0 | 7.5 | 15 | 22.5 |
| Corn | 60.83 | 55.78 | 50.68 | 45.58 |
| Soybean meal (46.5% CP) | 34.25 | 31.91 | 29.57 | 27.24 |
| Dried distillers grains with solubles | --- | 7.50 | 15.00 | 22.50 |
| Choice white grease | 1.50 | 1.50 | 1.50 | 1.50 |
| Dicalcium phosphate (18.5% P) | 1.45 | 1.20 | 1.00 | 0.80 |
| Limestone | 0.80 | 0.90 | 1.00 | 1.10 |
| Salt | 0.35 | 0.35 | 0.35 | 0.35 |
| L-lysine HCl | 0.30 | 0.35 | 0.40 | 0.45 |
| DL-methionine | 0.10 | 0.09 | 0.07 | 0.06 |
| L-threonine | 0.12 | 0.12 | 0.12 | 0.12 |
| Vitamin and trace mineral premix | 0.30 | 0.30 | 0.30 | 0.30 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |
| | | | | |
| Calculated analysis | | | | |
| Standardized ileal digestible amino acids | | | | |
| Lysine, % | 1.29 | 1.29 | 1.29 | 1.29 |
| Methionine:lysine ratio, % | 31% | 31% | 31% | 31% |
| Met & Cys:lysine ratio, % | 55.9% | 56.6% | 57.3% | 58.0% |
| Threonine:lysine ratio, % | 63.5% | 64.0% | 64.4% | 64.8% |
| Tryptophan:lysine ratio, % | 17.91% | 17.47% | 17.03% | 16.60% |
| ME, kcal/lb | 1,533 | 1,536 | 1,538 | 1,540 |
| Lysine:ME ratio, g/Mcal | 3.82 | 3.81 | 3.80 | 3.80 |
| Protein, % | 21.5 | 22.1 | 22.6 | 23.1 |
| Ca, % | 0.74 | 0.72 | 0.71 | 0.70 |
| P, % | 0.67 | 0.65 | 0.64 | 0.62 |
| Available P, % | 0.41 | 0.41 | 0.41 | 0.41 |

**Table 2. Diet composition (Exp. 2)**

| Ingredients, % | Control diet | 15% DDGS[1] | 4% soy hulls | DDGS + soy hulls |
|---|---|---|---|---|
| Corn | 60.83 | 50.72 | 57.46 | 47.30 |
| Soybean meal (46.5% CP) | 34.24 | 29.43 | 33.71 | 28.89 |
| DDGS | --- | 15.00 | --- | 15.00 |
| Soy hulls | --- | --- | 4.00 | 4.00 |
| Choice white grease | 1.50 | 1.50 | 1.50 | 1.50 |
| Dicalcium phosphate (18.5% P) | 1.45 | 1.05 | 1.40 | 1.05 |
| Limestone | 0.80 | 1.05 | 0.75 | 1.00 |
| Salt | 0.35 | 0.35 | 0.35 | 0.35 |
| L-lysine HCl | 0.30 | 0.40 | 0.30 | 0.40 |
| DL-methionine | 0.10 | 0.07 | 0.10 | 0.07 |
| L-threonine | 0.12 | 0.12 | 0.12 | 0.12 |
| Vitamin and trace mineral premix | 0.30 | 0.30 | 0.30 | 0.30 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |
| | | | | |
| Calculated analysis | | | | |
| Standardized ileal digestible amino acids | | | | |
| Lysine, % | 1.29 | 1.29 | 1.29 | 1.29 |
| Methionine:lysine ratio, % | 31% | 31% | 31% | 31% |
| Met & Cys:lysine ratio, % | 55.9% | 57.3% | 55.0% | 56.4% |
| Threonine:lysine ratio, % | 63.5% | 64.4% | 63.1% | 63.9% |
| Tryptophan:lysine ratio, % | 17.9% | 17.0% | 17.7% | 16.8% |
| ME, kcal/lb | 1,533 | 1,537 | 1,512 | 1,515 |
| Lysine:ME ratio, g/Mcal | 3.82 | 3.81 | 3.87 | 3.86 |
| Protein, % | 21.5 | 22.6 | 21.5 | 22.5 |
| Ca, % | 0.74 | 0.74 | 0.74 | 0.75 |
| P, % | 0.67 | 0.65 | 0.66 | 0.64 |
| Available P, % | 0.42 | 0.42 | 0.42 | 0.42 |

[1] Dried distillers grains with solubles.

**Table 3. Effects of increasing dried distillers grains with solubles (DDGS) in nursery diets on pig performance and survival rate (Exp. 1)**[1]

| | DDGS, % | | | | | |
|---|---|---|---|---|---|---|
| Item | 0 | 7.5 | 15 | 22.5 | SE | *P* values |
| ADG, lb | 1.12 | 1.13 | 1.14 | 1.14 | 0.01 | 0.26 |
| ADFI, lb | 1.67 | 1.66 | 1.62 | 1.64 | 0.02 | 0.21 |
| F/G | 1.50 | 1.47 | 1.43 | 1.44 | 0.02 | 0.004 |
| | | | | | | |
| Avg wt, lb | | | | | | |
| d 21[2] | 24.0 | 24.1 | 24.1 | 24.0 | 0.2 | 0.91 |
| d 42 | 47.5 | 47.8 | 48.1 | 48.0 | 0.4 | 0.43 |
| | | | | | | |
| Survival, % | 99.0% | 99.5% | 99.2% | 99.2% | 0.5 | 0.83 |

[1] Each number is the mean of 6 feeders (1 barrow pen and 1 gilt pen per feeder with 22 pigs per pen initially).
[2] The trial began 21 d after weaning.

**Table 4. Effects of dried distillers grains with solubles (DDGS) and soybean hulls in nursery diets on pig performance and survival rate (Exp. 2)**[1]

| | | | | | *P* values | | | |
|---|---|---|---|---|---|---|---|---|
| Item | Control | 15% DDGS | 4% soy hulls | 15% DDGS & 4% soy hulls | SE | DDGS | Soy hulls | DDGS × soy hulls |
| ADG, lb | 1.23 | 1.23 | 1.22 | 1.20 | 0.01 | 0.30 | 0. 09 | 0.26 |
| ADFI, lb | 1.81[a] | 1.73[b] | 1.77[ab] | 1.74[b] | 0.02 | 0.25 | 0.35 | 0.01 |
| F/G | 1.47[a] | 1.41[b] | 1.45[ab] | 1.45[ab] | 0.02 | 0.07 | 0.61 | 0.09 |
| Avg wt, lb | | | | | | | | |
| d 21[2] | 27.2 | 27.3 | 27.3 | 27.3 | 0.3 | 0.95 | 0.92 | 0.99 |
| d 42 | 53.1 | 53.2 | 53.0 | 52.4 | 0.4 | 0.42 | 0.23 | 0.50 |
| Survival, % | 99.5 | 99.7 | 100.0 | 99.7 | 0.2 | 0.31 | 0.31 | 1.00 |

[1] Each number is the mean of 6 feeders (1 barrow pen and 1 gilt pen per feeder with 22 pigs per pen initially).
[2] The trial began 21 d after weaning.
[ab] Within a row, means without a common superscript letter differ ($P < 0.05$).