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Abstract

Two experiments were conducted to determine the effects of sorghum dried distillers grains with solubles (DDGS) on nursery pig growth performance. In both experiments, sorghum DDGS were added to corn- or sorghum-based diets to determine their impact on ADG, ADFI, and F/G. In Exp. 1, a total of 360 nursery barrows (PIC 1050, initially 15.1 lb and 26 d of age) were used with 5 pigs per pen and 9 pens per treatment. Pigs were allotted to 1 of 8 dietary treatments arranged in a 2 Ã— 4 factorial with main effects of grain source (corn vs. sorghum) and sorghum DDGS (0, 15, 30, or 45%). Overall (d 0 to 34), pigs fed the corn and sorghum diets had similar ADG and ADFI; however, F/G was poorer (P < 0.05) for pigs fed the sorghum-based diets compared with the corn-based diets. Also, increasing DDGS reduced ADG (linear, P < 0.01) but increased ADFI (linear, P < 0.07), resulting in poorer F/G (linear, P < 0.01). In Exp. 2, a total of 180 nursery pigs (PIC 327 Ã— 1050, initially 23.8 lb and 38 d of age) were used in a 21-d study with 6 pigs per pen and 5 pens per treatment. The dietary treatments were arranged in a 2 Ã— 3 factorial with main effects of grain source (corn vs. sorghum) and DDGS (none, 30% corn DDGS, or 30% sorghum DDGS). Overall (d 0 to 21), no differences were found in ADG, ADFI, and F/G among pigs fed the corn- or sorghum-based diets. DDGS source (corn vs. sorghum) also did not influence growth performance; however, adding 30% DDGS to either the corn- or sorghum-based diets tended to reduce ADG (P < 0.10). Pigs fed diets with DDGS had similar ADFI and F/G when compared with pigs fed the basal diets (0% DDGS). In conclusion, sorghum can be used as a suitable replacement for corn in nursery diets. In Exp. 1, feed efficiency was approximately 5% poorer in pigs fed sorghum-based diets vs. pigs fed corn-based diets, which is similar to the energy content differences between the two grains. However, increasing sorghum DDGS to 45% of the diet reduced pig growth performance, so its inclusion needs to be evaluated on an income over feed costs basis.; Swine Day, Manhattan, KS, November 17, 2011

Keywords

Swine Day, 2011; Kansas Agricultural Experiment Station contribution; no. 12-064-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1056; Swine; Corn; Corn DDGS; Sorghum; Sorghum DDGS; Nursery pig

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The Effects of Sorghum Dried Distillers Grains with Solubles on Nursery Pig Performance[1]

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Summary

Two experiments were conducted to determine the effects of sorghum dried distillers grains with solubles (DDGS) on nursery pig growth performance. In both experiments, sorghum DDGS were added to corn- or sorghum-based diets to determine their impact on ADG, ADFI, and F/G. In Exp. 1, a total of 360 nursery barrows (PIC 1050, initially 15.1 lb and 26 d of age) were used with 5 pigs per pen and 9 pens per treatment. Pigs were allotted to 1 of 8 dietary treatments arranged in a 2 × 4 factorial with main effects of grain source (corn vs. sorghum) and sorghum DDGS (0, 15, 30, or 45%). Overall (d 0 to 34), pigs fed the corn and sorghum diets had similar ADG and ADFI; however, F/G was poorer ($P < 0.05$) for pigs fed the sorghum-based diets compared with the corn-based diets. Also, increasing DDGS reduced ADG (linear, $P < 0.01$) but increased ADFI (linear, $P < 0.07$), resulting in poorer F/G (linear, $P < 0.01$).

In Exp. 2, a total of 180 nursery pigs (PIC 327 × 1050, initially 23.8 lb and 38 d of age) were used in a 21-d study with 6 pigs per pen and 5 pens per treatment. The dietary treatments were arranged in a 2 × 3 factorial with main effects of grain source (corn vs. sorghum) and DDGS (none, 30% corn DDGS, or 30% sorghum DDGS). Overall (d 0 to 21), no differences were found in ADG, ADFI, and F/G among pigs fed the corn- or sorghum-based diets. DDGS source (corn vs. sorghum) also did not influence growth performance; however, adding 30% DDGS to either the corn- or sorghum-based diets tended to reduce ADG ($P < 0.10$). Pigs fed diets with DDGS had similar ADFI and F/G when compared with pigs fed the basal diets (0% DDGS).

In conclusion, sorghum can be used as a suitable replacement for corn in nursery diets. In Exp. 1, feed efficiency was approximately 5% poorer in pigs fed sorghum-based diets vs. pigs fed corn-based diets, which is similar to the energy content differences between the two grains. However, increasing sorghum DDGS to 45% of the diet reduced pig growth performance, so its inclusion needs to be evaluated on an income over feed costs basis.

Key words: corn, corn DDGS, sorghum, sorghum DDGS, nursery pig

Introduction

Producers from Texas to South Dakota have grown sorghum for many years due to its ability to thrive in drought conditions. This large production of sorghum accompanied by the rapid increase in demand for grain for ethanol production has resulted in an availability of sorghum DDGS in this area.

[1] The authors thank the United Sorghum Checkoff Program for partial financial support.
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Sorghum has an energy value of 96% that of corn and can be a complete replacement for corn when formulated in swine diets (Carter et al., 1989[3]); however, with the advent of low-tannin varieties and with proper feed processing and diet formulation, in many cases sorghum has been shown to have performance equal to corn in swine diets. Although a large amount of information is known about the nutritional value of sorghum, little is known about its by-product, sorghum DDGS. With an increasing amount of sorghum DDGS available, more research needs to be conducted to determine its impact on pig growth performance. Therefore, the objective of this study was to compare corn- vs. sorghum-based diets and determine the effects of increasing sorghum DDGS on nursery pig growth performance.

Procedures

The protocol for this experiment was approved by the Kansas State University Institutional Animal Care and Use Committee. Experiment 1 was conducted at the K-State Segregated Early Weaning Facility, Manhattan, KS, and Exp. 2 was conducted at the K-State Swine Teaching and Research Center.

In Exp. 1, a total of 360 nursery barrows (PIC 1050, 15.1 lb and 26 d of age) were used in a 34-d trial to determine the effects of increasing sorghum DDGS on growth performance. After arrival to the nursery, pigs were fed a common pre-test diet for the first 7 d after weaning. Pens of pigs were then allotted to 1 of 8 dietary treatments with 5 pigs per pen (5 × 5 ft) and 9 replications per treatment. Each pen had metal slatted floors, one 5-hole self-feeder, and a nipple waterer. Throughout the study, the pigs had ad libitum access to feed and water.

The dietary treatments were arranged in a 2 × 4 factorial with main effects of grain source (corn vs. sorghum) and sorghum DDGS (0, 15, 30, or 45%). Sorghum and corn nutrient values were derived from NRC (1998[4]; Table 1). Standardized ileal digestibility values for the sorghum DDGS were derived from Urriola et al. (2009[5]). Other nutrient values for the sorghum DDGS were derived from previous analysis of sorghum DDGS samples collected from the ethanol plant earlier in the year (Sotak et al., 2010[6]). Dietary treatments were fed in 2 phases (d 0 to 14 and d 14 to 34; Tables 2 and 3). All pigs and feeders were weighed on d 0, 14, and 34 to determine ADG, ADFI, and F/G.

In Exp. 2, a total of 180 nursery pigs (PIC 327 × 1050, 23.8 lb, and 38 d of age) were used in a 21-d trial to determine the effects of grain and DDGS source on growth performance. After arrival to the nursery, pigs were fed common pre-test diets for 17 d postweaning. Pens of pigs were then allotted to 1 of 6 dietary treatments with 6 pigs per pen (4 × 5 ft) and 5 replications per treatment. Each pen had slatted floors, one 5-hole

[3] Carter, P. R., D. R. Hicks, E. S. Oplinger, J. D. Doll, L. G. Bundy, R. T. Schuler, and B. J. Holmes. 1989. Grain sorghum. Alternative Field Crops Manual. University of Wisconsin-Extension Cooperative Extension, Madison and University of Minnesota: Center for Alternative Plant and Animal Products and the Minnesota Extension Service, Minneapolis.

[4] NRC. 1998. Nutrient Requirements of Swine. 10th ed. National Academy Press, Washington, DC.

[5] Urriola, P. E., D. Hoehler, C. Pederson. H. H. Stein, and G. C Shurson. 2009 Amino acid digestibility of distillers dried grains with solubles produced from a sorghum-a sorghum-corn blend, and corn fed to pigs. J. Anim. Sci. 87:2574-2580.

[6] Sotak et al., Swine Day 2010, Report of Progress 1038, pp. 265-272.

self-feeder, and a nipple waterer. Throughout the study, the pigs had ad libitum access to feed and water.

The dietary treatments were arranged in a 2 × 3 factorial with main effects of grain source (corn vs. sorghum) and DDGS (none, 30% corn DDGS, or 30% sorghum DDGS). The corn, sorghum, and sorghum DDGS nutrient values were the same as those used in Exp. 1. Corn DDGS values were from Stein, 2007[7]. Dietary treatments were fed for 21 d (Table 4). All pigs and feeders were weighed on d 0, d 7, d 14, and d 21 to determine ADG, ADFI, and F/G.

Data were analyzed in a completely randomized design with pen as the experimental unit. Analysis of variance was used with the MIXED procedure of SAS (SAS Institute, Inc., Cary, NC). For Exp. 1, contrasts were used to make comparisons between the (1) linear and quadratic interactions of DDGS level × grain source, (2) corn- and sorghum-based diets, and (3) linear and quadratic effects of increasing DDGS. In Exp. 2, contrasts were used to make comparisons between the (1) interaction of DDGS × grain source, (2) corn- and sorghum-based diets, and (3) effects of 30% DDGS.

Results and Discussion

In Exp. 1, from d 0 to 14, grain source did not influence ADG or ADFI; however, ADG was reduced (linear, $P < 0.05$) as sorghum DDGS increased in the diet due to a tendency ($P = 0.07$) for lower ADFI (interactive effects, Table 5; main effects, Table 6). A DDGS × grain source interaction ($P = 0.05$) was observed for F/G. In corn-based diets, increasing sorghum DDGS had relatively little effect on F/G, whereas increasing DDGS in sorghum-based diets tended to worsen F/G, leading to a trend (quadratic, $P = 0.09$) for poorer F/G as DDGS level increased.

From d 14 to 34, no differences were found in ADG among pigs fed corn- or sorghum-based diets; however, ADFI was greater ($P < 0.04$) and F/G became poorer ($P < 0.01$) among pigs fed sorghum-based diets compared with those fed corn-based diets. Whether in sorghum- or corn-based diets, increasing sorghum DDGS decreased ADG (linear, $P < 0.01$) and worsened (linear, $P < 0.01$) F/G.

Overall (d 0 to 34), ADG and ADFI was similar among the pigs fed the corn- and sorghum-based diets; however, F/G for pigs fed corn-based diets was improved ($P < 0.05$) by approximately 5% compared with pigs fed sorghum-based diets. Increasing DDGS resulted in poorer ADG (linear, $P < 0.01$) and ADFI (linear, $P < 0.07$). A quadratic DDGS × grain source interaction ($P < 0.03$) was observed for F/G. As sorghum DDGS increased in corn-based diets, feed efficiency was identical for pigs fed 0, 15, and 30% DDGS, but worsened for those fed 45% DDGS. In sorghum-based diets, F/G was best for those fed 0% DDGS, but worsened in pigs fed 15, 30, or 45% DDGS. Similar to the response for ADG, increasing DDGS resulted in decreased final weight (linear, $P < 0.01$).

[7] Stein, H. 2007. Dried distillers grains with solubles (DDGS) in diets fed to swine. In: Swine Focus-#001. pp. 1-8.

In Exp. 2, overall (d 0 to 21), no grain source × DDGS interaction was observed for ADG, ADFI, and F/G (Table 7). Pigs fed diets containing either corn or sorghum DDGS had similar growth performance with no difference in final weight.

As in Exp. 1, no difference in ADG and ADFI was observed among pigs fed corn- or sorghum-based diets; however, in Exp. 2, F/G was similar for pigs fed corn-based diets compared with those fed sorghum-based diets (Table 8). Increasing the level of DDGS from 0 to 30% reduced ($P < 0.03$) ADG, numerically decreased ($P = 0.14$) F/G, and did not influence ADFI.

In conclusion, grain sorghum can be a suitable replacement for corn in nursery pig diets, with the exception of slightly poorer F/G, possibly related to its decreased energy content. Although increasing sorghum DDGS in the diet reduced ADG, increasing sorghum DDGS in the corn-based diets worsened F/G only when fed at the 45% level. Increasing sorghum DDGS in sorghum-based diets reduced F/G in a linear manner. The economic value of ADG and F/G must be evaluated when considering adding sorghum DDGS to nursery diets. The decrease in pig growth performance will need to be offset by a reduction in diet cost when using sorghum DDGS; therefore, its inclusion needs to be evaluated on an income over feed cost basis.

Table 1. Formulated and analyzed nutrient composition of ingredients

	Sorghum		Corn		Sorghum DDGS[1]	
Item	Formulated[2]	Analyzed[3]	Formulated[2]	Analyzed[3]	Formulated[2,4]	Analyzed[3]
DM, %	89.00	86.12	89.00	86.22	88.64	89.64
CP, %	10.34	9.56	9.33	8.58	27.70	32.39
Crude fat, %	3.26	2.40	4.38	2.73	9.35	8.00
Crude fiber, %	---	2.03	---	2.00	8.25	5.88
Ash, %	---	1.50	---	1.51	4.45	4.73
Amino acids, %						
Cysteine	0.17	0.13	0.19	0.14	0.44	0.44
Isoleucine	0.37	0.28	0.28	0.22	1.13	1.04
Leucine	1.21	0.95	0.99	0.76	2.93	2.94
Lysine	0.22	0.21	0.26	0.22	0.78	0.73
Methionine	0.17	0.12	0.17	0.13	0.42	0.39
Threonine	0.31	0.24	0.29	0.22	0.86	0.85
Tryptophan	0.10	0.06	0.06	0.05	0.22	0.15
Valine	0.36	0.37	0.39	0.32	1.38	1.34

[1] Dried distillers grains with solubles.
[2] Diets prepared using the formulated values derived from the NRC 1998, Nutrient Requirements of Swine, 10th ed. National Academy Press, Washington DC.
[3] Values represent the mean of 1 sample analyzed in duplicate.
[4] Sotak et al., Swine Day 2010, Report of Progress 1038, pp. 265-272.

Table 2: Composition of diets, (d 0 to 14, Exp. 1, as-fed basis)[1]

	Corn				Sorghum			
	Sorghum dried distillers grains with solubles (DDGS), %							
Item	0%	15%	30%	45%	0%	15%	30%	45%
Ingredient, %								
Corn	56.63	44.86	33.10	21.18	---	---	---	---
Sorghum	---	---	---	---	60.05	47.50	35.05	22.40
Soybean meal (46.5% CP)	25.38	22.34	19.31	16.29	21.76	19.54	17.17	14.95
Sorghum DDGS	---	15.00	30.00	45.00	---	15.00	30.00	45.00
Spray-dried whey	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Select menhaden fish meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Monocalcium P (21% P)	0.90	0.50	0.15	---	0.85	0.50	0.13	---
Limestone	0.65	0.85	1.00	1.08	0.70	0.85	1.05	1.10
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Zinc oxide	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
L-Lysine HCl	0.24	0.28	0.32	0.36	0.38	0.39	0.40	0.41
DL-Methionine	0.15	0.13	0.11	0.09	0.19	0.16	0.14	0.11
L-Threonine	0.11	0.09	0.08	0.06	0.14	0.12	0.10	0.08
Total	100	100	100	100	100	100	100	100
Calculated analysis								
Standardized ileal digestible amino acids, %								
Lysine	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Isoleucine:lysine	61	64	67	70	60	64	67	70
Methionine:lysine	37	36	36	36	39	38	38	37
Met & Cys:lysine	60	60	60	60	60	60	60	60
Threonine:lysine	63	63	63	63	63	63	63	63
Tryptophan:lysine	17	17	17	17	17	17	17	17
Valine:lysine	68	72	76	80	66	71	75	79
Total lysine, %	1.43	1.46	1.49	1.51	1.41	1.44	1.47	1.50
CP, %	21.4	23.1	24.9	26.6	20.6	22.5	24.4	26.3
ME kcal/lb	1,499	1,467	1,435	1,401	1,478	1,451	1,423	1,394
Ca, %	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
P, %	0.75	0.72	0.71	0.73	0.73	0.71	0.70	0.73
Available P, %	0.46	0.46	0.46	0.51	0.46	0.46	0.46	0.51

[1] Diets were fed in meal form from d 0 to 14 of the experiment, which began 7 d after weaning.

Table 3: Composition of diets, (d 14 to 34, Exp. 1, as-fed basis)[1]

	Corn				Sorghum			
	Sorghum dried distillers grains with solubles (DDGS), %							
Item	0%	15%	30%	45%	0%	15%	30%	45%
Ingredient, %								
Corn	64.23	51.27	38.45	25.63	---	---	---	---
Sorghum	---	---	---	---	65.10	52.00	38.90	25.95
Soybean meal (46.5% CP)	31.67	29.91	28.00	26.08	30.78	29.17	27.56	25.79
Sorghum DDGS	---	15.00	30.00	45.00	---	15.00	30.00	45.00
Monocalcium P (21% P)	1.63	1.25	0.88	0.50	1.58	1.20	0.85	0.48
Limestone	0.85	1.03	1.20	1.38	0.88	1.05	1.20	1.38
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Zinc oxide	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
L-Lysine HCl	0.36	0.36	0.35	0.37	0.39	0.38	0.38	0.38
DL-Methionine	0.17	0.13	0.10	0.06	0.20	0.15	0.11	0.07
L-Threonine	0.15	0.12	0.08	0.04	0.15	0.12	0.08	0.04
Total	100	100	100	100	100	100	100	100
Calculated analysis								
Standardized ileal digestible amino acids, %								
Lysine	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
Isoleucine:lysine	59	63	67	72	60	64	68	72
Methionine:lysine	35	33	32	31	36	34	33	31
Met & Cys:lysine	57	57	57	57	57	57	57	57
Threonine:lysine	62	62	62	62	62	62	62	62
Tryptophan:lysine	17	17	17	17	17	17	17	17
Valine:lysine	65	71	77	83	66	72	78	83
Total lysine, %	1.38	1.40	1.43	1.46	1.37	1.40	1.43	1.46
CP, %	20.7	22.9	25.1	27.2	20.9	23.0	25.2	27.3
ME kcal/lb	1,496	1,463	1,431	1,399	1,473	1,445	1,418	1,390
Ca, %	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
P, %	0.74	0.72	0.71	0.69	0.73	0.72	0.71	0.69
Available P, %	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42

[1] Diets were fed in meal form from d 14 to 34 of the experiment.

Table 4. Composition of diets, (d 0 to d 21, Exp. 2, as-fed basis)[1]

	Grain source					
	Corn			Sorghum		
	DDGS[2] source and level, %					
Item	None 0%	Milo 30%	Corn 30%	None 0%	Milo 30%	Corn 30%
Ingredient, %						
Corn	64.85	41.30	40.75	---	---	---
Sorghum	---	---	---	68.45	43.80	43.15
Soybean meal (46.5% CP)	31.35	25.25	25.90	27.50	22.60	23.35
Sorghum DDGS	---	30.00	---	---	30.00	---
Corn DDGS	---	---	30.00	---	---	30.00
Monocalcium P (21% P)	1.20	0.45	0.50	0.12	0.40	0.45
Limestone	0.93	1.30	1.30	0.98	1.35	1.35
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Zinc oxide	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15
Lysine HCl	0.37	0.45	0.43	0.51	0.55	0.53
DL-Methionine	0.16	0.13	0.04	0.22	0.17	0.06
L-Threonine	0.13	0.11	0.05	0.18	0.13	0.08
Natuphos 600	0.08	0.08	0.08	0.08	0.08	0.08
Total	100	100	100	100	100	100
Calculated analysis						
Standardized ileal digestible amino acids, %						
Lysine	1.27	1.27	1.27	1.27	1.27	1.27
Isoleucine: lysine	60	66	65	59	65	64
Methionine: lysine	35	35	31	39	37	32
Met & Cys: lysine	60	60	60	60	60	60
Threonine: lysine	62	62	62	63	62	62
Tryptophan: lysine	17	17	17	17	17	17
Valine: lysine	67	75	75	65	73	74
Total lysine, %	1.40	1.45	1.46	1.38	1.44	1.45
CP, %	20.6	24.1	24.1	19.8	23.6	23.6
ME, kcal/lb	1,500	1,436	1,494	1,477	1,421	1,480
Ca, %	0.70	0.70	0.70	0.70	0.70	0.70
P, %	0.65	0.61	0.61	0.63	0.59	0.59
Available P, %	0.42	0.42	0.42	0.42	0.42	0.42

[1] Diets were fed in meal from d 0 to 21 of the experiment.
[2] Dried distillers grains with solubles.

Table 5: Effects of sorghum dried distillers grains with solubles (DDGS) on nursery pig performance (Exp.1)[1]

	Grain source									Probability, $P <$				
	Corn				Sorghum					DDGS × grain source			DDGS	
	Sorghum DDGS, %													
Item	0%	15%	30%	45%	0%	15%	30%	45%	SED	Linear	Quadratic	Corn vs. sorghum[2]	Linear	Quadratic
Initial wt, lb	15.2	15.1	15.1	14.9	15.1	15.1	15.1	15.1	0.38	0.60	0.83	0.82	0.63	0.91
d 0 to 14														
ADG, lb	0.69	0.67	0.65	0.62	0.74	0.68	0.63	0.66	0.05	0.49	0.46	0.53	0.01	0.49
ADFI, lb	1.03	1.02	0.97	0.91	0.97	1.03	0.97	0.98	0.06	0.33	0.90	0.98	0.07	0.28
F/G	1.52	1.54	1.50	1.48	1.33	1.53	1.55	1.49	0.04	0.05	0.24	0.45	0.28	0.09
d 14 to 34														
ADG, lb	1.35	1.33	1.29	1.18	1.32	1.29	1.33	1.24	0.05	0.16	0.70	0.70	0.01	0.15
ADFI, lb	2.12	2.09	2.05	1.96	2.13	2.17	2.19	2.10	0.09	0.25	0.62	0.04	0.14	0.29
F/G	1.58	1.58	1.58	1.67	1.61	1.68	1.65	1.69	0.01	0.60	0.06	0.01	0.01	0.38
d 0 to 34														
ADG, lb	1.08	1.05	1.03	0.95	1.08	1.04	1.04	1.03	0.04	0.51	0.57	0.60	0.01	0.47
ADFI, lb	1.67	1.65	1.60	1.53	1.65	1.70	1.69	1.62	0.07	0.24	0.67	0.14	0.07	0.23
F/G	1.56	1.56	1.56	1.62	1.53	1.64	1.62	1.64	0.01	0.49	0.03	0.05	0.01	0.50
Final wt, lb	52.0	50.9	49.9	47.1	51.9	50.3	50.5	49.1	1.77	0.39	0.51	0.53	0.01	0.61

[1] A total of 360 nursery barrows (PIC 1050, initially 15.1 lb and 7 d postweaning) were used in a 34-d growth trial to evaluate the effects on growth performance of grain source and increasing sorghum DDGS on pig performance. There were 5 pigs per pen and 9 pens per treatment.

[2] Contrast compares the mean of pigs fed sorghum-based diets with DDGS (0, 15, 30, and 45%) with the means of pigs fed the corn-based diets (0, 15, 30, and 45% DDGS).

Table 6. Main effects of grain source and sorghum dried distillers grains with solubles (DDGS) on nursery pig performance (Exp. 1)[1]

	Grain source			Sorghum DDGS, %					Probability, $P <$		
										DDGS level	
Item	Corn	Sorghum	SED	0%	15%	30%	45%	SED	Grain source	Linear	Quadratic
d 0 to 14											
ADG, lb	0.66	0.67	0.02	0.72	0.67	0.64	0.63	0.03	0.53	0.01	0.49
ADFI, lb	0.98	0.98	0.03	1.00	1.03	0.97	0.93	0.05	0.98	0.07	0.28
F/G	1.51	1.48	0.04	1.43	1.53	1.52	1.49	0.06	0.45	0.28	0.09
d 14 to 34											
ADG, lb	1.29	1.30	0.03	1.33	1.31	1.31	1.21	0.04	0.70	0.01	0.15
ADFI, lb	2.06	2.14	0.04	2.12	2.13	2.12	2.03	0.06	0.04	0.14	0.29
F/G	1.60	1.66	0.02	1.59	1.63	1.62	1.68	0.02	0.01	0.01	0.38
d 0 to 34											
ADG, lb	1.03	1.04	0.02	1.08	1.05	1.03	0.97	0.03	0.60	0.01	0.47
ADFI, lb	1.61	1.67	0.04	1.66	1.68	1.65	1.58	0.05	0.14	0.07	0.23
F/G	1.58	1.61	0.02	1.54	1.60	1.59	1.63	0.02	0.05	0.01	0.50
Weight, lb											
d 0	15.0	15.1	0.09	15.1	15.1	15.1	15.0	0.27	0.82	0.63	0.91
d 14	24.2	24.5	0.44	25.1	24.5	24.0	23.8	0.62	0.57	0.02	0.64
d 34	49.9	50.5	0.89	51.8	50.6	50.2	48.1	1.25	0.53	0.01	0.61

[1] A total of 360 nursery barrows (PIC 1050, initially 15.1 lb and 7 d postweaning) were used in a 34-d growth trial to evaluate the effects on growth performance of grain source and increasing sorghum DDGS on pig performance. There were 5 pigs per pen and 9 pens per treatment.

Table 7. An evaluation of corn and sorghum dried distillers grains with solubles (DDGS) on nursery pigs performance (Exp. 2)[1]

	Treatments										
	A	B	C	D	E	F					
	Grain source										
	Corn			Sorghum				Probability, *P* <			
	DDGS source and level, %										
Item	None 0%	Sorghum 30%	Corn 30%	None 0%	Sorghum 30%	Corn 30%	SED	Grain source × DDGS interaction	Corn vs. sorghum[2]	Corn DDGS vs. sorghum DDGS[3]	Control vs. DDGS[4]
d 0 to 21											
ADG, lb	1.17	1.09	1.13	1.19	1.15	1.10	0.04	0.38	0.56	0.86	0.03
ADFI, lb	1.78	1.81	1.77	1.90	1.85	1.76	0.07	0.39	0.21	0.25	0.32
F/G	1.53	1.66	1.57	1.60	1.61	1.61	0.02	0.22	0.51	0.24	0.14
Weight, lb											
d 0	23.6	23.6	23.7	23.6	23.6	23.6	0.79	1.00	0.93	0.94	0.96
d 21	48.1	46.6	48.6	47.7	46.7	46.7	1.28	0.60	0.73	0.96	0.13

[1] A total of 180 nursery pigs (PIC 327 × 1050, initially 23.8 lb and 38 d of age) were used in a 21-d growth trial to determine the effects of corn or sorghum DDGS (0, 30%) on growth performance. There were 6 pigs per pen and 5 pens per treatment.
[2] Corn vs. sorghum (treatment A, B, and C vs. treatment D, E, and F).
[3] Corn DDGS vs. sorghum DDGS (treatment C and F vs. treatment B and E).
[4] Basal diets vs. diets with sorghum or corn DDGS (treatment A and D vs. treatment B, C, E, and F).

Table 8. Main effects of grain source and dried distillers grains with solubles (DDGS) on nursery pig performance (Exp. 2)[1]

	Grain source			DDGS source			DDGS level, %			Probability, *P*<		
Item	Corn	Sorghum	SED	Corn	Sorghum	SED	0%	30%	SED	Grain source	DDGS source	DDGS level[2]
d 0 to 21												
ADG, lb	1.13	1.15	0.03	1.12	1.12	0.03	1.18	1.12	0.02	0.56	0.86	0.03
ADFI, lb	1.79	1.84	0.04	1.77	1.83	0.05	1.84	1.80	0.02	0.21	0.25	0.32
F/G	1.58	1.60	0.03	1.59	1.63	0.04	1.56	1.61	0.02	0.51	0.24	0.14
Weight, lb												
d 0	23.6	23.6	0.45	23.6	23.6	0.56	23.6	23.6	0.28	0.93	0.94	0.96
d 21	47.4	47.6	0.74	47.1	47.1	0.91	48.3	47.1	0.45	0.73	0.96	0.13

[1] A total of 180 nursery pigs (PIC 327 × 1050, initially 23.8 lb and 38 d of age) were used in a 21-d growth trial to determine the effects of corn or sorghum DDGS (0, 30%) on growth performance. There were 6 pigs per pen and 5 pens per treatment.
[2] Values for 30% DDGS include corn and sorghum DDGS.