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Effects of Increasing Concentrations of Distillers Dried Grains with Solubles (DlDGS) on Growth Performance of Weaning Pigs

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Feeding low concentrations of DDGS early in the nursery period does not help to maintain growth performance when high concentrations of DDGS are incorporated in the diets during the late nursery period.

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Summary

The objective of this experiment was to evaluate growth performance of weanling pigs introduced to low concentrations (5%) of DDGS during phase 2 of the nursery period followed by high concentrations (30%) during phase 3 of the nursery period. Overall (day 0 to 42), pigs fed 5 or 30% DDGS in phase 2 (and 30% DDGS in phase 3) had decreased ($P < 0.05$) average daily gain (ADG) compared to control pigs. In addition, pigs fed 30% DDGS (during phase 2 and 3) had decreased ($P < 0.05$) body weight (BW) compared to control pigs and pigs that only received DDGS during phase 3. However, pigs fed 0% DDGS during phase 2 (followed by 30% DDGS in phase 3) had similar BW, ADG and average daily feed intake compared to pigs fed the control diet. This research indicates that the inclusion of DDGS during phase 2 of the nursery may negatively affect growth performance, particularly when followed by inclusion of high concentrations of DDGS during phase 3 of the nursery period. However, growth performance may be maintained when high concentrations of DDGS are included in the diets of pigs (with no previous exposure to DDGS) late in the nursery period.

Introduction

Distillers dried grains with solubles (DDGS) is the primary co-product of ethanol production that is used in the swine industry. Incorporation of DDGS in swine diets is expected to grow rapidly because of its improved quality and increased availability. To date, much of the research documenting the effects of DDGS is focused on growing-finishing pig performance. Little emphasis has been placed on the effects of DDGS on nursery pig performance. Currently, some nutritionists recommend that DDGS should not be fed at concentrations greater than 5% of the diet during the nursery phase. However, because little emphasis has been placed on research documenting the growth performance of nursery pigs fed DDGS (particularly high quality DDGS from new generation ethanol plants), DDGS may be underutilized in nursery-pig diets. The objective this research was to evaluate growth performance of weanling pigs introduced to low concentrations (5%) of DDGS during phase 2 of the nursery period followed by high concentrations (30%) during phase 3 of the nursery period.

Materials and Methods

Experimental design

Ninety-six weaned (17 to 19 days post-farrowing) pigs were sorted by weight and sex and randomly allotted to dietary treatment in a 42-day experiment (4 treatments; 6 pigs/pen; 4 replicates/treatment) that was conducted at the University of Nebraska–Lincoln. Average initial body weight was 12.3 lb. During phase 1 (days 1 to 7) all pigs were fed a common transition diet, during phase 2 (days 8 to 21) and 3 (days 22 to 42) the 4 dietary treatments (Table 1) were arranged as follows: 1) basal diet (CTL; 0% DDGS in phase 2 and 3); 2) 0% DDGS (0% DDGS in phase 2, 30% DDGS in phase 3); 3) 5% DDGS (5% DDGS in phase 2, 30% DDGS in phase 3); and 4) 30% DDGS (30% DDGS in phase 2 and 3). All diets were fed in meal form and formulated to meet or exceed NRC requirements for growth without growth-promoting antibiotics, zinc oxide, or copper sulfate. All pigs were housed in a temperature-controlled room with constant lighting. Each pen contained a single nipple waterer and a single self-feeder to facilitate ad libitum access to water and feed. Pig weights and feed disappearance measurements were obtained on day 7, 21, and 42. Pig body weight (BW) and feed disappearance were measured weekly and used to calculate average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (G:F).

Statistical analyses

Growth data were analyzed as a completely randomized design using the MIXED procedure of SAS. The main effect of the statistical models was dietary treatment. Pen was considered as the experimental unit for analyses.

Results and Discussion

Pig BW and growth performance results are summarized in Table 2. At the end of phase 1 (day 7; during which all pigs were fed a transition diet) pig BW averaged 14.2 lb. As expected, BW and growth performance during phase 1 (days 0 to 7) were not affected by dietary treatment. At the end of phase 2 (day 21), pig BW was similar among treatments and averaged 23.7, 23.6, 22.7, and 21.2 lb for pigs fed the control, 0% DDGS, 5% DDGS, and 30% DDGS diets, respectively. During phase 2, no differences in growth performance were observed between pigs fed 5% DDGS compared to pigs fed the control diet. However,

Table 1. Composition of phase 2 (P2)[a,b] and phase 3 (P3)[a,c] diets (as-fed basis) %.

	Control		0% DDGS		5% DDGS		30% DDGS	
Ingredient, %	P2	P3	P2	P3	P2	P3	P2	P3
Corn	43.90	58.96	43.90	37.51	41.00	37.51	22.80	37.51
Soybean meal, 47.5 % CP	32.00	35.00	32.00	26.75	29.98	26.75	23.43	26.75
Spray dried whey	15.00	0.00	15.00	0.00	15.00	0.00	15.00	0.00
Select menhaden fish meal	4.00	0.00	4.00	0.00	4.00	0.00	4.00	0.00
Corn oil	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Dicalcium phosphate, 21% P	1.00	1.65	1.00	0.75	0.90	0.75	0.25	0.75
Limestone	0.35	0.63	0.35	1.23	0.40	1.23	0.80	1.23
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
UNL mineral mix[d]	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
UNL vitamin mix[e]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine•HCl	0.00	0.04	0.00	0.04	0.00	0.04	0.00	0.04
DL-methionine	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
DDGS[f]	0.00	0.00	0.00	30.00	5.00	30.00	30.00	30.00
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a]Control = 0% DDGS in phase 2 and 3; 0% DDGS = 0% DDGS in phase 2 and 30% DDGS in phase 3; 5% DDGS = 5% DDGS in phase 2 and 30% DDGS in phase 3; 30% DDGS = 30% DDGS in phase 2 and 3.
[b]Phase 2 diets were formulated to contain: lysine, 1.4% ; Ca, 0.85% ; P, 0.7% ; available P, 0.47%.
[c]Phase 3 diets were formulated to contain: lysine, 1.24% ; Ca, 0.81% ; P, 0.71% ; available P, 0.36%.
[d]Supplied per kg of diet: Zn (as ZnO), 128 mg; Fe (as $FeSO_4 \cdot H_2O$), 128 mg; Mn (as MnO), 30 mg; Cu (as $CuSO_4 \cdot 5H_2O$), 11 mg; I (as $Ca(IO_3) \cdot H_2O$), 0.26 mg; Se (as Na_2SeO_3), 0.3 mg.
[e]Supplied per kg of diet: vitamin A (as retinyl acetate, 5,500 IU; vitamin D (as cholecalciferol), 550 IU; vitamin E (as α-tocopheryl acetate), 30 IU; vitamin K (as menadione dimethylpyrimidinol bisulfate), 4.4 mg; riboflavin, 11.0 mg; d-pantothenic acid, 22.05 mg; niacin, 33.0 mg; vitamin B_{12} (as cyanocobalamin), 33.0 mg.
[f]Distillers dried grains with solubles.

Table 2. Body weights (BW), average daily gain (ADG), average daily feed intake (ADFI) and feed efficiency (G:F) of nursery pigs fed various dietary concentrations of distillers dried grains with solubles (DDGS).[a]

	Dietary Treatments[b]					*P*-values
	Control	0% DDGS	5% DDGS	30% DDGS	SEM[c]	treatment
BW, lb						
day 0	12.1	12.4	12.5	12.3	0.46	0.8
day 7	14.4	14.3	14	14	0.27	0.3
day 21	23.7	23.6	22.7	21.2	0.43	0.3
day 42	55.2[d]	52.8[d]	51.6[de]	48.7[e]	1.08	0.003
Phase 1 (day 0 to 7)						
ADG, lb	0.33	0.28	0.21	0.23	0.06	0.6
ADFI, lb	0.4	0.41	0.33	0.37	0.02	0.16
G:F, lb/lb	0.81	0.7	0.61	0.61	0.18	0.8
Phase 2 (day 8 to 21)						
ADG, lb	0.67[d]	0.66[d]	0.63[d]	0.52[e]	0.02	0.001
ADFI, lb	1.00[d]	1.05[d]	0.97[d]	0.8[e]	0.05	0.03
G:F, lb/lb	0.68	0.64	0.64	0.63	0.03	0.7
Phase 3 (day 22 to 42)						
ADG, lb	1.50[d]	1.39[de]	1.38[e]	1.31[e]	0.05	0.03
ADFI, lb	2.28[d]	2.13[d]	2.09[d]	1.79[e]	0.09	0.01
G:F, lb/lb	0.66[d]	0.66[d]	0.66[d]	0.73[e]	0.02	0.01
Overall (day 0 to 42)						
ADG, lb	1.03[d]	0.96[de]	0.93[ef]	0.86[f]	0.03	0.003
ADFI, lb	1.54[d]	1.48[d]	1.43[d]	1.23[e]	0.05	0.005
G:F, lb/lb	0.67	0.65	0.65	0.71	0.02	0.1

[a]A total of 96 pigs (initially 12.3 ± 0.2 lb and 18 ± 1 d of age at weaning) with six pigs per pen and four pens per treatment.
[b]Control = 0% DDGS in phase 2 and 3; 0% DDGS = 0% DDGS in phase 2 and 30% DDGS in phase 3; 5% DDGS = 5% DDGS in phase 2 and 30% DDGS in phase 3; 30% DDGS = 30% DDGS in phase 2 and 3.
[c]Standard error of the mean.
[d-f]Means in the same row with different superscripts differ ($P < 0.05$).

pigs fed 30% DDGS had decreased ADG and ADFI compared to all other treatments ($P < 0.05$). At the end of phase 3 (day 42), pig BW was similar among treatments averaging 23.7, 23.6, 22.7 and 21.2 lb, respectively for pigs fed the control, 0% (0% in phase 2 and 30% in phase 3), 5% (5% in phase 2 and 30% in phase 3), and 30% (30% in phase 2 and 3) diets. During phase 3, pigs that received the control diet had greater ADG ($P < 0.05$) compared to pigs that received DDGS (including both the 5 and 30% DDGS treatments) during phase 2 of the experiment. In addition, pigs that received 30% DDGS (in both phase 2 and 3) had decreased ($P < 0.05$) ADFI and increased ($P < 0.05$) G:F compared to pigs fed the control diet.

Overall (day 0 to 42), pigs fed 30% DDGS (during both phase 2 and 3) had decreased ADG and ADFI compared to pigs fed the control diet ($P < 0.05$). In addition, BW (averaging 55.2, 52.8, 51.6, and 48.7 lb, respectively for pigs fed the control, 0, 5, or 30% DDGS treatment diets) for pigs fed 30% DDGS was decreased compared to all other treatments ($P < 0.05$). However, pigs that were introduced to 30% DDGS late in the nursery (received 30% DDGS during phase 3 only) had similar BW and growth performance compared to control pigs.

Conclusions

This research indicates that the inclusion of DDGS at low concentrations during phase 2 did not help to maintain growth performance when high concentrations of DDGS were included during phase 3 and that inclusion of high levels (30%) of DDGS throughout the nursery period has a negative effect on growth performance. However, growth performance may be maintained when high levels of DDGS (30%) are included during the late nursery period (phase 3).

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