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Utilizing Dried Distillers Grains With Solubles and Phytase to Alleviate Phosphorus Costs in Finishing Swine

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Growth performance of growing-finishing pigs was maintained when calcium-phosphates were reduced or replaced with dried distillers grains, phytase, or both.

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Summary

A total of 24 barrows (86.7 lb) were used over a 12-week experiment to evaluate the effects of utilizing dried distillers grains with solubles (DDGS) and phytase as alternatives to inorganic phosphorus (P) sources. Pigs were assigned to 1 of 4 dietary treatments. Treatments consisted of a common corn and soybean-meal fortified diet (CSB), a diet similar to CSB with phytase added in place of dicalcium-phosphate, a corn and soybean-meal diet with 20% DDGS, and a diet with 20% DDGS and phytase added in place of dicalcium-phosphate. Treatment did not affect (P > 0.10) pig performance for any of the growth criteria measured. Utilizing DDGS and phytase together helped to numerically reduce the price per ton of feed compared to the other treatments in the experiment. The results of this experiment suggest that alternatives such as DDGS and phytase can be used to manipulate the necessary inclusion rate of calcium-phosphates needed in the growing-finishing phase of swine production.

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Introduction

Previously (Fall 2008), calcium-phosphates commonly used in swine diets dramatically increased in price. Phosphorus supplementation can be one of the most expensive components in diets formulated for swine. Because feed contributes up to 70% of the total cost of production, methods to lower feed costs without affecting performance can be helpful in lowering operating costs. The objective of this experiment was to evaluate the effects of DDGS and phytase, separately and together, as alternatives that could reduce the amount of calcium-phosphates needed to meet phosphorus requirements.

Procedures

Animals and Facilities

Animal use and procedures for the experiment were approved by the Institutional Animal Care and Use Committee of the University of Nebraska–Lincoln. The 12-week study used 24 crossbred barrows (initial BW = 86.7 lb). Animals were individually penned in an environmentally-controlled room with ad libitum access to feed and water. Barrows were randomly assigned to 1 of 4 dietary treatments (six pigs/treatment) for the duration of the experiment.

Dietary Treatments

The 4 dietary treatments included: a traditional corn-soybean meal diet (CSB); a CSB with 1,000 FTU of a commercially available phytase (*E. coli derived*) and no supplemental inorganic phosphorus (P); a CSB with 20% DDGS inclusion; and a CSB with 20% DDGS inclusion 1,000 FTU of phytase and no supplemental inorganic P (Tables 1, 2, and 3). Pigs were fed in 3 dietary phases (Phase 1, 90 to 130 lb; Phase 2, 130 to 180 lb; Phase 3, 180 to 260 lb). Diets were formulated to meet or exceed nutrient requirements based on NRC (1998) values, except for P which was formulated to be adequate in available P for the CSB and 20% DDGS without phytase

Table 1. Ingredient and calculated composition of the grower diet (90 to 125 lb), as-fed basis.

	Treatment			
DDGS[a], %	**0**	**0**	**20**	**20**
Phytase[b], FTU[c]	**0**	**1,000**	**0**	**1,000**
Ingredient, %				
Corn	78.71	79.01	62.80	62.95
Soybean meal-47.5% CP[d]	18.76	18.73	14.79	14.78
DDGS	0.00	0.00	20.00	20.00
Phytase	0.00	0.05	0.00	0.05
Dicalcium phosphate	0.86	0.00	0.49	0.00
Limestone	0.90	1.43	1.14	1.44
Salt	0.30	0.30	0.30	0.30
Vitamin premix[e]	0.20	0.20	0.20	0.20
Trace mineral premix[f]	0.15	0.15	0.15	0.15
Antibiotic[g]	0.03	0.03	0.03	0.03
L-Lysine•HCl	0.10	0.10	0.10	0.10
Calculated analysis, %				
Total lysine, %	0.85	0.85	0.85	0.85
CP, %	15.54	15.55	17.99	17.99
Calcium, %	0.60	0.60	0.60	0.60
Phosphorus, %	0.51	0.35	0.49	0.40
Available phosphorus, %	0.22	0.06	0.22	0.13
ME[h], kcal[i]/lb	1,512	1,516	1,558	1,560
Calculated cost/ton				
August 27, 2008, $/ton	250.9	244.4	238.8	235.9

[a]DDGS = Corn dried distillers grains with solubles.
[b]Optiphos®, JBS United (Sheridan, Ind.).
[c]FTU = phytase units.
[d]CP = Crude protein.
[e]Supplied per kilogram of diet at 0.2% inclusion: vitamin A as retinyl acetate, 4,400 IU; cholecalciferol, 440 IU; α-tocopherol acetate, 24 IU; menadione sodium bisulfite, 3.5 mg; riboflavin 8.8 mg; d-pantothenic acid, 17.6 mg; niacin, 26.4 mg; vitamin B_{12}, 26.4 mg.
[f]Supplied per kilogram of diet at 0.15% inclusion: Zn (as $ZnSO_4$), 128 mg; Fe (as $FeSO_4•H_2O$), 128 mg; Mn (as MnO), 30 mg; Cu ($CuSO_4•5\,H_2O$), 10.5 mg; I (as $Ca(IO_3)•H_2O$), 0.26 mg; Se (as Na_2SeO_3), 0.26 mg.
[g]Tylan®, Elanco Animal Health (Greenfield, Ind.).
[h]ME = Metabolizable energy.
[i]kcal = kilocalories.

Table 2. Ingredient and calculated composition of finisher 1 diets (125 to 185 lb), as-fed basis.

	Treatment			
DDGS[a], %	**0**	**0**	**20**	**20**
Phytase[b], FTU[c]	**0**	**1,000**	**0**	**1,000**
Ingredient, %				
Corn	84.30	84.55	68.40	68.49
Soybean meal-47.5% CP[d]	13.31	13.29	9.34	9.34
DDGS	0.00	0.00	20.00	20.00
Phytase	0.00	0.05	0.00	0.05
Dicalcium phosphate	0.73	0.00	0.37	0.00
Limestone	0.89	1.34	1.11	1.35
Salt	0.30	0.30	0.30	0.30
Vitamin premix[e]	0.20	0.20	0.20	0.20
Trace mineral premix[f]	0.15	0.15	0.15	0.15
Antibiotic[g]	0.03	0.03	0.03	0.03
L-Lysine•HCl	0.10	0.10	0.10	0.10
Calculated analysis, %				
Total lysine, %	0.70	0.70	0.70	0.70
CP, %	13.41	13.42	15.86	15.87
Calcium, %	0.55	0.55	0.55	0.55
Phosphorus, %	0.46	0.33	0.45	0.38
Available phosphorus, %	0.19	0.05	0.19	0.12
ME[h], kcal[i]/lb	1,515	1,519	1,561	1,562
Calculated cost/ton				
August 27, 2008, $/ton	245.1	239.8	233.0	231.3

[a]DDGS = Corn dried distillers grains with solubles.
[b]Optiphos®, JBS United (Sheridan, Ind.).
[c]FTU = phytase units.
[d]CP = Crude protein.
[e]Supplied per kilogram of diet at 0.2% inclusion: vitamin A as retinyl acetate, 4,400 IU; cholecalciferol, 440 IU; α-tocopherol acetate, 24 IU; menadione sodium bisulfite, 3.5 mg; riboflavin 8.8 mg; d-pantothenic acid, 17.6 mg; niacin, 26.4 mg; vitamin B_{12}, 26.4 mg.
[f]Supplied per kilogram of diet at 0.15% inclusion: Zn (as $ZnSO_4$), 128 mg; Fe (as $FeSO_4•H_2O$), 128 mg; Mn (as MnO), 30 mg; Cu ($CuSO_4•5\,H_2O$), 10.5 mg; I (as $Ca(IO_3)•H_2O$), 0.26 mg; Se (as Na_2SeO_3), 0.26 mg.
[g]Tylan®, Elanco Animal Health (Greenfield, Ind).
[h]ME = Metabolizable energy.
[i]kcal = kilocalories.

Table 3. Ingredient and calculated composition of finisher 2 diets (185 to 260 lb), as-fed basis.

	Treatment			
DDGS[a], %	**0**	**0**	**20**	**20**
Phytase[b], FTU[c]	**0**	**1,000**	**0**	**1,000**
Ingredient, %				
Corn	89.89	90.09	73.98	74.03
Soybean meal-47.5%CP[d]	7.86	7.85	3.90	3.89
DDGS	0.00	0.00	20.00	20.00
Phytase	0.00	0.05	0.00	0.05
Dicalcium phosphate	0.61	0.00	0.24	0.00
Limestone	0.87	1.24	1.11	1.26
Salt	0.30	0.30	0.30	0.30
Vitamin premix[e]	0.20	0.20	0.20	0.20
Trace mineral premix[f]	0.15	0.15	0.15	0.15
Antibiotic[g]	0.03	0.03	0.03	0.03
L-Lysine•HCl	0.10	0.10	0.10	0.10
Calculated analysis, %				
Total lysine, %	0.55	0.55	0.55	0.55
CP, %	11.29	11.30	13.74	13.74
Calcium, %	0.50	0.50	0.50	0.50
Phosphorus, %	0.42	0.31	0.40	0.36
Available phosphorus, %	0.16	0.05	0.16	0.12
ME[h], kcal[i]/lb	1,518	1,521	1,564	1,565
Calculated cost/ton				
August 27, 2008, $/ton	239.2	235.2	227.1	226.8

[a]DDGS = Corn dried distillers grains with solubles.
[b]Optiphos®, JBS United (Sheridan, Ind.).
[c]FTU = phytase units.
[d]CP = Crude protein.
[e]Supplied per kilogram of diet at 0.2% inclusion: vitamin A as retinyl acetate, 4,400 IU; cholecalciferol, 440 IU; α-tocopherol acetate, 24 IU; menadione sodium bisulfite, 3.5 mg; riboflavin 8.8 mg; d-pantothenic acid, 17.6 mg; niacin, 26.4 mg; vitamin B_{12}, 26.4 mg.
[f]Supplied per kilogram of diet at 0.15% inclusion: Zn (as $ZnSO_4$), 128 mg; Fe (as $FeSO_4 \bullet H_2O$), 128 mg; Mn (as MnO), 30 mg; Cu ($CuSO_4 \bullet 5\, H_2O$), 10.5 mg; I (as $Ca(IO_3) \bullet H_2O$), 0.26 mg; Se (as Na_2SeO_3), 0.26 mg.
[g]Tylan®, Elanco Animal Health (Greenfield, Ind.).
[h]ME = Metabolizable energy.
[i]kcal = kilocalories.

Table 4. Growth performance data from the dietary treatments.

	Treatment					
DDGS, %	0	0	20	20		
Phytase, FTU	0	1,000	0	1,000		
Number of pigs	6	6	6	6	SEM[a]	*P*-value treatment
Grower (90 to 125 lb)						
ADG[c], lb	2.11	1.73	1.87	2.04	0.11	0.13
ADFI[d], lb	5.29	4.75	5.02	5.51	0.23	0.13
G:F[e], lb/lb	0.40	0.36	0.37	0.37	0.02	0.65
Finisher 1 (125 to 185 lb)						
ADG, lb	2.21	2.24	2.23	2.19	0.16	0.99
ADFI, lb	6.66	6.68	6.68	6.99	0.42	0.94
G:F, lb/lb	0.33	0.34	0.34	0.32	0.02	0.90
Finisher 2 (185 to 260 lb)						
ADG, lb	2.08	2.25	1.93	2.01	0.22	0.78
ADFI, lb	7.93	7.91	7.72	7.44	0.55	0.91
G:F, lb/lb	0.26	0.28	0.25	0.27	0.02	0.63
Overall (90 to 260 lb)						
ADG, lb	2.13	2.16	2.02	2.08	0.15	0.96
ADFI, lb	6.89	6.76	6.74	6.84	0.36	0.99
G:F, lb/lb	0.31	0.31	0.30	0.31	0.02	0.95

[a]SEM = Standard error of the mean.
[b]BW = Body weight.
[c]ADG = Average daily gain.
[d]ADFI = Average daily feed intake.
[e]G:F = Gain to feed ratio.

treatments (Table 1). Inclusion of 20% DDGS allowed for a reduction in the amount of dicalcium-phosphate needed to meet P requirements. Based on claims by the manufacturers of the phytase product used, 0.05% added phytase liberates up to 0.20% available P. Therefore, the available P shown in Table 1 represents only the available P estimates before phytase liberation of additional available P. Phytase inclusion remained the same for all 3 phases to supply available P at or above the requirements.

Data Collection

Pigs and feeders were weighed at the beginning and end of each phase. Estimated feed disappearance was calculated by the difference between feed added and the amount of feed remaining in the feeder. Body weight gain was estimated using the difference of the observed weight at the end and the beginning weight of each phase. Based on the feed disappearance and body weight gain data, average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (G:F) were estimated.

Statistical Analysis

Data were analyzed using the MIXED procedure (SAS Inst. Inc. Cary, N.C.). Each animal was considered the experimental unit. The model was a completely randomized design.

Results and Discussion

The growth performance data are provided in Table 4. During the grower period (90 to 125 lb) treatment did not affect ADG, ADFI, or G:F ($P > 0.10$). Numerically, pigs fed the diet with phytase inclusion and no DDGS exhibited the lowest for ADG and ADFI (1.73 and 4.75 lb, respectively). This difference (although only numeric) could be due to the P requirement of barrows during this phase of growth (90 to 125 lb) compared to the amount of P that the phytase needed to liberate in conjunction with decreased feed intake. During the grower period, the

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combination of DDGS and phytase resulted in the greatest reduction of price per ton ($15) compared to the traditional diet without affecting animal performance.

During the second and third phase feeding periods of the experiment (125 to 185 and 185 to 260 lb, respectively) there were no differences in ADG, ADFI, or G:F ($P > 0.10$). Numerical differences between treatments were small, which would indicate that phytase and DDGS inclusion in diets separately or together can reduce or eliminate the need of calcium-phosphates during the last stages of production.

There were no differences observed among the treatments during the three phases of the experiment or the growing-finishing period overall (90 to 260 lb) for the animal performance characteristics measured. The costs per ton of each dietary treatment indicates that the addition of DDGS and phytase separately or together can reduce feed cost based on August 27, 2008 prices. The greatest reduction in feed cost (up to $15/ton) was observed when both DDGS and phytase were used together. It is important to note that DDGS inclusion in diets can also reduce the amount of other ingredients which also contribute to the reduction in feed cost. These results are in agreement with concurrent research conducted at other universities which have concluded that DDGS along with phytase inclusions in nursery diets can alleviate any need for supplementing diets with calcium-phosphates. The results of this experiment indicate that proper formulation of diets with phytase and DDGS can reduce or alleviate dependence on traditional phosphorus sources in swine grower-finisher diets.

Conclusions

Overall, animal performance did not differ when alternative methods of P supplementation were used in growing-finish pigs (90 to 260 lb). These results suggest that expensive sources of P can be omitted from diets in order to decrease feed costs without altering animal growth parameters.

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