

INFLUENCE OF NUTRIDENSE LOW PHYTATE¹ CORN AND ADDED FAT ON GROWING-FINISHING PIG GROWTH PERFORMANCE

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Summary

Two studies were conducted to evaluate the effect of NutriDense Low Phytate corn in conjunction with increasing amounts of added fat on growing and finishing pig performance. NutriDense Low Phytate corn is similar to NutriDense corn, but with greater available phosphorus content because it has less phytate phosphorus. Both experiments were conducted at a commercial swine research facility in southwest Minnesota. In Exp. 1, 1,162 gilts (initially 98.3 lb) were used in a 28-d study. Pigs were blocked by weight, and were randomly allotted to one of six dietary treatments. Pigs were fed diets based on corn-soybean meal with yellow dent (YD) or NutriDense Low Phytate corn and 0, 3, or 6% added fat, in a 2 × 3 factorial arrangement. A constant true ileal digestible (TID) lysine:energy ratio of 2.80 g TID lysine:Mcal ME was maintained in all diets, as well a constant available P:energy ratio of 0.90 g/Mcal. Overall (d 0 to 28), there were no corn source × fat content interactions ($P>0.79$). Regardless of corn source, ADG and F/G improved linearly ($P<0.03$, and $P<0.01$, respectively) as the amount of fat increased in the diet. There were no differences in growth performance between pigs fed diets containing NutriDense Low Phytate and those fed YD corn.

In Exp. 2, a total of 1,128 gilts (initially 180.0 lb) were used in a 28-d growth assay. Pigs were blocked, and were randomly allotted to one of six dietary treatments. Pigs were fed similarly to those in Exp. 1, with diets based on corn-soybean meal, using either NutriDense Low Phytate or YD corn and 0, 3, or 6% added fat. A constant TID lysine:energy ratio of 2.15 g/Mcal ME was maintained in all diets, as well as a constant available P:energy ratio of 0.75 g/Mcal. Overall (d 0 to 28), there was a tendency for a corn source × fat content interaction for F/G ($P<0.07$), which was a result of pigs fed YD corn having improved F/G only at 6% added fat, whereas improvements were seen in pigs fed NutriDense Low Phytate at both 3 and 6% added fat. Also, there was an improvement in ADG (linear $P<0.01$) and F/G (linear, $P<0.01$) as the amount of fat increased in the diet, regardless of corn source. There was no difference in growth performance between pigs fed diets containing NutriDense Low Phytate and those fed YD corn.

These studies indicate that increasing amounts of added fat improved growth performance, regardless of corn source. Pig growth performance is similar for pigs fed NutriDense Low Phytate corn and fed YD corn, although NutriDense Low Phytate corn does

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have the advantage of having higher amino acid concentrations and less phytate phosphorus.

(Key Words: Pigs, Yellow Dent Corn, NutriDense Low Phytate Corn.)

Introduction

NutriDense corn is a nutritionally enhanced product containing a stacked set of traits to provide greater nutrient density than conventional yellow dent corn. Although not higher in tryptophan, NutriDense Low Phytate corn does also have high amounts of amino acids, including 19% more lysine, 5% more sulfur amino acids, 6% more threonine, and 5% more energy than normal corn. Previous trials with nursery, growing and finishing pigs at Kansas State University indicated that the energy value of NutriDense corn was approximately 5% greater than the energy density of YD corn. In these trials, F/G was improved linearly through the highest energy content (6% fat added to a diet containing NutriDense corn). NutriDense Low Phytate corn is similar to NutriDense corn, but with greater available phosphorus content due to less phytate content (Table 1). Research from the University of Illinois suggested that the energy value of NutriDense Low Phytate corn was less than the energy of NutriDense corn, but higher than YD corn. Few growth trials have been conducted on the feeding value of NutriDense Low Phytate corn. Thus, the objective of these trials was to determine the value of NutriDense Low Phytate corn, compared with YD corn, in growing and finishing pigs.

Procedures

General. Procedures used in these experiments were approved by the Kansas State University Animal Care and Use Committee. Both trials were conducted at a commercial research facility in southwest Minnesota. The facility had a totally slatted floor, with ap-

proximately 7.2 ft² provided per pig. Each pen was equipped with a four-hole dry self feeder and one cup waterer. The facility was a double curtain-sided, deep-pit barn that operated on mechanical ventilation during the summer and on automatic ventilation during the winter. Experiments 1 and 2 were run in fall and winter, respectively. Pigs were randomly allotted and blocked to one of six dietary treatments with seven pens per treatment. Pigs and feeders were weighed on d 0, 14, and 28 to determine the response criteria of ADG, ADFI, and F/G.

Table 1. Nutrient Composition of Corn Sources (As-fed Basis)

Item	YD Corn ^a	NutriDense Low Phytate Corn ^b	
		Calculated	Analyzed
Lysine, %	0.26	0.32	0.32
Isoleucine, %	0.28	0.41	0.36
Leucine, %	0.99	1.35	1.25
Methionine, %	0.17	0.21	0.18
Met & Cys, %	0.36	0.43	0.38
Threonine, %	0.29	0.34	0.31
Tryptophan, %	0.06	0.08	0.06
Valine, %	0.39	0.55	0.49
ME, kcal/kg	3,420	3,591	3,591
CP, %	8.5	10.00	9.65
Ca, %	0.03	0.03	0.03
P, %	0.28	0.32	0.30
Available P, %	0.04	0.16 ^c	0.15 ^c

^aYellow dent corn values are from NRC (1998).

^bCalculated and analyzed values of NutriDense Low Phytate corn courtesy of BASF. The calculated values were used in diet formulation.

^cAvailability of the P in NutriDense Low Phytate corn was assumed to be 50%.

Experiment 1. A total of 1,162 gilts (BW of 98.3 lb) were used in a 28-d growth assay. Each pen contained 25 to 28 pigs. Experimental diets (Table 2) were fed in meal form. The 6 dietary treatments were arranged in a 2 × 3 factorial, with diets based on YD or NutriDense Low Phytate corn containing 0, 3, or 6% added fat. A constant TID lysine:energy

ratio of 2.80 g/Mcal ME was maintained in all diets. The available P:energy ratio was 0.90 g/Mcal in all diets.

Experiment 2. A total of 1,128 gilts (BW of 180 lb) were used in a 28-d growth assay. There were also 6 experimental dietary treatments, with 7 pens/treatment and 25 to 29 pigs per pen. Similar to those in Exp. 1, dietary treatments included diets based on corn-soybean meal, with YD or NutriDense Low Phytate corn and 0, 3, or 6% added fat (Table 3). A constant TID lysine:energy ratio of 2.15 g/Mcal ME was maintained in all diets. The available P:energy ratio was 0.75 g/Mcal for all diets.

Statistical Analysis. Data were analyzed as a randomized complete-block design by using the PROC MIXED procedure of SAS, with pen as the experimental unit in both experiments. Tests for interactions between corn source and lysine concentrations were performed. Contrasts were used to determine the effect of corn source and fat addition, and linear and quadratic polynomial contrasts were used to determine the effects of increasing added fat.

Results and Discussion

The analyzed amino acid and mineral concentrations for NutriDense Low Phytate were similar to the calculated values used in diet formulation. The crude protein content and content of a few amino acids were slightly less in the analyzed values, but none of the differences were large enough to impact the experimental results.

Experiment 1. Overall (d 0 to 28), there were no corn source \times fat content interactions (Table 4, $P>0.79$). Regardless of corn source, ADG increased (linear, $P<0.03$) and F/G improved (linear, $P<0.01$) as the content of fat

increased in the diet (Table 5). There were no differences in pig growth performance between NutriDense Low Phytate and YD corn.

Experiment 2. Overall (d 0 to 28), there was a tendency for a corn source \times fat content interaction ($P<0.07$, Table 6) for F/G. For pigs fed YD corn, F/G was only improved when 6% fat was added to the diet, whereas a linear improvement was found with increasing fat content for pigs fed NutriDense Low Phytate corn. Main effects indicated a linear improvement in ADG ($P<0.01$) and F/G ($P<0.01$) as the amount of fat increased in the diet (Table 7). There was no difference in growth performance between pigs fed NutriDense Low Phytate and those fed YD corn.

Results were similar to those in previous trials at Kansas State University; increasing the energy content of the diet by adding fat increased ADG and improved F/G in these experiments. These studies indicate that increasing amounts of added fat improved growth performance, regardless of corn source. Pig growth performance was similar for pigs fed NutriDense Low Phytate corn and those fed YD corn, although NutriDense Low Phytate does have added environmental advantages because of the low phytate phosphorus concentrations. This was evident because NutriDense Low Phytate corn diets required 37 to 63% less phosphorus supplementation, compared with the YD corn diets. The analyzed NutriDense Low Phytate corn had less methionine, cystine, threonine, tryptophan, and phosphorus than the calculated values of NutriDense Low Phytate corn. Because the higher amino acid and available P concentrations in NutriDense Low Phytate corn were accounted for in diet formulation, similar growth performance between pigs fed NutriDense Low Phytate and YD corn indicates that the formulation values for these nutrients in NutriDense Low Phytate corn are appropriate.

Table 2. Composition of Diets (Exp. 1; As-fed Basis)^a

Item	Corn Source	Yellow Dent			NutriDense Low Phytate		
	Added Fat, %	0	3	6	0	3	6
Ingredient, %							
Corn		71.60	66.82	62.04	-	-	-
NutriDense Low Phytate		-	-	-	71.80	67.00	62.20
Soybean meal, (46.5%)		26.14	27.87	29.60	26.25	27.97	29.70
Choice white grease		-	3.00	6.00	-	3.00	6.00
Monocalcium phosphate, (21% P)		0.73	0.78	0.83	0.37	0.45	0.52
Limestone		0.90	0.90	0.90	0.95	0.95	0.95
Salt		0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix		0.08	0.08	0.08	0.08	0.08	0.08
Trace mineral premix		0.10	0.10	0.10	0.10	0.10	0.10
L- lysine HCL		0.10	0.10	0.10	0.10	0.10	0.10
Total		100	100	100	100	100	100
Calculated Values							
Total lysine, %		1.05	1.09	1.13	1.10	1.14	1.17
True ileal digestible amino acids							
Lysine, %		0.93	0.97	1.01	0.97	1.01	1.04
Lysine:ME ratio, g/Mcal		2.80	2.80	2.80	2.80	2.80	2.80
Methionine:lysine ratio, %		29	28	27	30	30	29
Met & cys:lysine ratio, %		59	58	56	62	60	58
Threonine:lysine ratio, %		63	63	62	64	63	63
Tryptophan:lysine ratio, %		20	20	20	21	21	21
ME, kcal/lb		1,514	1,574	1,635	1,574	1,630	1,687
Calcium, %		0.59	0.60	0.61	0.54	0.56	0.58
Phosphorus, %		0.53	0.54	0.55	0.49	0.50	0.51
Available phosphorus, %		0.22	0.23	0.25	0.23	0.25	0.26
Avail P:calorie ratio, g/mcal		0.90	0.90	0.90	0.90	0.90	0.90

^aDiets fed in meal form from d 0 to 28.

Table 3. Composition of Diets (Exp. 2. as-fed Basis)^a

Item	Corn Source	Yellow Dent			NutriDense Low Phytate		
	Added Fat, %	0	3	6	0	3	6
Ingredient, %							
Corn		80.34	75.89	71.46	-	-	-
NutriDense® Low Phytate		-	-	-	80.95	76.45	72.00
Soybean meal, (46.5%)		17.58	18.98	20.36	17.33	18.76	20.14
Choice white grease		-	3.00	6.00	-	3.00	6.00
Monocalcium phosphate, (21% P)		0.65	0.70	0.75	0.24	0.31	0.38
Limestone		0.85	0.85	0.85	0.90	0.90	0.90
Salt		0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix		0.05	0.05	0.05	0.05	0.05	0.05
Trace mineral premix		0.08	0.08	0.08	0.08	0.08	0.08
L- lysine HCL		0.10	0.10	0.10	0.10	0.10	0.10
Total		100	100	100	100	100	100
Calculated Values							
Total lysine, %		0.82	0.85	0.88	0.86	0.89	0.92
True ileal digestible amino acids							
Lysine, %		0.72	0.75	0.78	0.75	0.78	0.81
Lysine:ME ratio, g/Mcal		2.15	2.15	2.15	2.15	2.15	2.15
Methionine:lysine ratio, %		32	33	30	34	33	32
Met & cys:lysine ratio, %		66	66	62	70	67	65
Threonine:lysine ratio, %		66	64	64	67	66	65
Tryptophan:lysine ratio, %		20	19	20	21	21	21
ME, kcal/lb		1,518	1,579	1,639	1,586	1,643	1,700
Calcium, %		0.53	0.54	0.55	0.47	0.49	0.50
Phosphorus, %		0.48	0.49	0.50	0.43	0.44	0.45
Available phosphorus, %		0.20	0.21	0.22	0.21	0.22	0.23
Avail P:calorie ratio, g/mcal		0.75	0.75	0.75	0.75	0.75	0.75

^aDiets fed in meal form from d 0 to 28.

Table 4. Means of Corn Source and Added Fat on Growth Performance (Exp. 1)^a

Item;	Corn Source: Added Fat, %	Yellow Dent			NutriDense Low Phytate			SE	Probability, P < Source × Fat %
		0	3	6	0	3	6		
D 0 to 28									
	ADG, lb	1.87	1.92	1.98	1.89	1.93	2.00	0.047	0.97
	ADFI, lb	4.14	4.12	4.08	4.30	4.13	4.15	0.108	0.79
	F/G	2.23	2.14	2.06	2.27	2.14	2.08	0.033	0.86

^aA total of 1,162 gilts (initially 98.3 lb), with 25 to 28 pigs per pen and 7 replications per treatment.

Table 5. Main Effects of Corn Source and Added Fat on Growth Performance (Exp. 1)^a

Item	Corn Source		SE	Added Fat (%)				Probability, P <			
	YD ^b	NDLP ^c		0	3	6	SE	Corn Source	Fat %	Fat %	
										Linear	Quadratic
D 0 to 28											
ADG, lb	1.92	1.94	0.029	1.88	1.92	1.99	0.034	0.59	0.08	0.03	0.75
ADFI, lb	4.11	4.19	0.074	4.22	4.12	4.11	0.084	0.34	0.53	0.30	0.61
F/G	2.14	2.16	0.020	2.25	2.14	2.07	0.024	0.49	0.01	0.01	0.58

^aA total of 1,162 gilts (initially 98.3 lb), with 25 to 28 pigs per pen and 7 replications per treatment.

^bYellow dent corn.

^cNutriDense Low Phytate corn.

Table 6. Means of Corn Source and Added Fat on Growth Performance (Exp. 2)^a

Item;	Corn Source:		YD ^b			NutriDense Low Phytate			SE	Probability, P < Source × Fat %
	Added Fat, %		0	3	6	0	3	6		
D 0 to 28										
ADG, lb			1.91	1.83	2.02	1.76	1.90	2.00	0.057	0.12
ADFI, lb			5.97	5.67	5.66	5.57	5.49	5.62	0.183	0.62
F/G			3.12	3.12	2.79	3.17	2.90	2.81	0.062	0.07

^aA total of 1,128 gilts (initially 180.0), with 25 to 28 pigs per pen and 42 pens, provided 7 replications per treatment.

^bYellow dent corn.

Table 7. Main Effects of Corn Source and Added Fat on Growth Performance (Exp. 2)^a

Item	Corn Source		SE	Added Fat (%)				Probability, P <			
	YD ^b	NDLP ^c		0	3	6	SE	Corn Source	Fat %	Fat %	
										Linear	Quadratic
D 0 to 28											
ADG, lb	1.92	1.89	0.033	1.83	1.86	2.01	0.040	0.50	0.01	0.01	0.22
ADFI, lb	5.77	5.56	0.106	5.77	5.58	5.64	0.130	0.18	0.58	0.49	0.44
F/G	3.01	2.96	0.036	3.15	3.01	2.80	0.043	0.33	0.01	0.01	0.49

^aA total of 1,128 gilts (initially 180.0 lb), with 25 to 28 pigs per pen, and 42 pens provided 7 replications per treatment.

^bYellow dent corn.

^cNutriDense Low Phytate corn.