EVALUATION OF GROUND CORN GERM AS AN ENERGY SOURCE IN NURSERY DIETS [1]

C. W. Hastad, M. D. Tokach, J. L. Nelssen, R. D. Goodband, and S. S. Dritz [2]

Summary

Two hundred eighty nursery pigs (initially 30.9 lb) were used in a 21-d growth assay to determine the energy value of ground corn germ relative to corn oil in nursery diets. Increasing dietary corn oil linearly decreased average daily feed intake and improved feed efficiency. However, pigs fed diets containing ground corn germ meal had similar gain and feed efficiency as those fed the corn-soybean meal diet without added fat. These results suggest that the added energy provided by corn germ is not utilized as well as that from corn oil.

(Key Words; Nursery Pigs, Corn Germ, Energy Source, Fat.)

Introduction

Corn germ is a by-product of the corn milling industry. It has a high fat content (45 to 50%) and can be handled as a free flowing product. Thus, corn germ may provide an opportunity for swine producers to increase energy density of diets. The greatest application may be in two specific areas. First, producers who cannot handle liquid fat sources easily in their on-farm feed mill may want to use corn germ to increase energy density. Second, some producers that are already using high fat diets would like to further increase the energy density, but cannot because of problems with flowability of the feed. Thus, corn germ may provide an opportunity to further increase energy density of the diet. Currently we are unaware of any data validating the use of corn germ as an energy source in swine diets. Therefore, our objective was to determine the energy value of corn germ relative to corn oil in diets for nursery pigs.

Procedures

Two hundred eighty nursery pigs (initially of 30.9 lb) were used in a 21-d growth assay. Pigs were blocked by weight and allotted to one of seven treatments. There were five pigs/pen and eight pens per treatment. Pigs were housed in the Kansas State University Segregated Early Weaning Facility. Each pen was 4 × 4 ft and contained one self-feeder and one nipple waterer to provide ad libitum access to feed and water.

Experimental diets included a corn-soybean meal control diet with no added fat. Additional diets included increasing amounts of oil (2, 4, and 6%) provided by either corn oil or corn germ. The composition of corn germ is shown in Table 1. All diets were formulated to the same lysine/calorie ratio of 3.82 g lysine/ Mcal of ME (Table 2). In diet formulation, corn germ was assumed to contain 50% of its weight as fat for an energy source. Average daily gain, average daily feed intake, and feed efficiency were determined by weighing pigs and measuring feed disappearance on d 7, 14, and 21 of the experiment.

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[2]Food Animal Health and Management Center.

Table 1. Nutrient Profile of Corn Germ[a]

Metabolizable energy, Kcal/lb	2,375
Nutrient composition, %	
Dry matter	95.44
Crude protein	14.17
Crude fat	45.03
Acid detergent fiber	10.31
Neutral detergent fiber	22.18
Ash	.85
Phosphorus	.37
Calcium	.02
Amino Acid Composition, %	
Tryptophan	0.11
Cystine	0.21
Methionine	0.26
Threonine	0.45
Serine	0.54
Glycine	0.59
Alanine	0.72
Isoleucine	0.69
Leucine	0.43
Tryosine	1.02
Phenylalanine	0.42
Lysine (Total)	0.54
Histidine	0.53
Arginine	0.37

[a]Nutrient values were provided by the supplier.
[b]A calculated energy value derived from an NRC (1998) equation estimating the kcal ME based on the nutrient composition of the feed ingredient.

Data was analyzed as a randomized complete block design with a pen as the experimental unit. Linear and quadratic polynomial contrasts were used to determine the effects of increasing levels of fat and fat source.

Results and Discussion

For the overall 21-d study, pigs fed diets containing corn oil had improved ($P<0.04$) ADG, ADFI, and F/G compared to those fed diets containing ground corn germ (Table 3 and 4). For the overall period, a fat source by level interaction was observed for F/G. The interaction was because F/G improved linearly when increasing levels of corn oil were added to the diet, whereas increasing fat from ground corn germ had no effect on performance. Pigs fed diets containing corn oil had decreased ADFI (linear, $P<0.005$) and improved feed efficiency (linear, $P<0.001$). However, increasing corn oil had no effect ($P>0.10$) on overall ADG. Overall pigs fed diets containing ground corn germ meal were similar in growth performance to those fed the control diet with no added fat. The response to corn oil is consistent with other research indicating that increasing the energy density of the diet decreases average daily feed intake and improves feed efficiency.

These findings suggest that the energy in ground corn germ meal is not as available as the energy in corn oil for nursery pigs. Ground corn germ contains a high amount of fiber (23.85%ADF and 43.36% NDF), which could explain the poorer performance. Although corn germ would be expected to have a high energy value because of its fat content, it appears that it is offset by its high fiber content. In conclusion, these data suggest that corn germ, despite containing 45 to 50% fat, does not improve feed efficiency compared with the same amount of added fat from corn oil.

Table 2. Diet Composition (As Fed Basis)

		Corn Oil			Ground Corn Germ		
Ingredient	Control	2%	4%	6%	2%	4%	6%
Corn	62.80	59.15	55.66	52.05	57.74	57.80	47.80
Soybean meal (46.5%)	33.38	35.02	36.51	38.11	34.44	35.35	36.37
Soybean oil		2	4	6			
Corn germ meal					4	8	12
Monocalcium phosphate (21% P)	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Limestone	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	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
Antibiotic[a]	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Lysine HCl	0.10	0.10	0.10	0.10	0.10	0.10	0.10
DL-methionine	0.015	0.015	0.015	0.015	0.015	0.015	0.015
TOTAL	100	100	100	100	100	100	100
Calculated Analysis							
Lysine, %	1.250	1.290	1.326	1.365	1.290	1.326	1.365
Isoleucine:lysine ratio, %	69	69	69	69	69	69	69
Leucine:lysine ratio, %	147	145	142	140	145	143	141
Methionine:lysine ratio, %	28	28	27	28	27	27	28
Met & Cys:lysine ratio, %	57	57	56	56	56	56	56
Threonine:lysine ratio, %	64	64	63	63	64	64	63
Tryptophan:lysine ratio, %	20	20	20	20	20	20	20
Fat, %	3.5	5.4	7.3	9.2	5.3	7.1	9.0
Protein, %	20.9	21.3	21.7	22.1	21.5	22.0	22.6
Available phosphorus, %	0.39	0.39	0.39	0.40	0.39	0.40	0.40
Lysine:calorie ratio, g/mcal	3.82	3.82	3.82	3.82	3.82	3.82	3.83

[a]Provided 50 g/ton carbadox.

Table 3. Effects of Fat Source from Corn Oil or Ground Corn Germ on Nursery Pigs[a]

		Corn Oil			Ground Corn Germ			
Item Fat Level	0 %	2 %	4%	6%	2 %	4%	6%	SEM
D 0 to 7								
ADG, lb	1.47	1.43	1.41	1.42	1.33	1.37	1.41	0.047
ADFI, lb	1.94	2.00	1.90	1.83	1.95	1.88	1.95	0.043
F/G	1.33	1.41	1.36	1.29	1.48	1.37	1.39	0.029
D 7 to 14								
ADG, lb	1.69	1.69	1.71	1.70	1.64	1.62	1.72	0.048
ADFI, lb	2.55	2.58	2.44	2.42	2.52	2.49	2.54	0.042
F/G	1.52	1.53	1.43	1.42	1.53	1.54	1.47	0.039
D 14 to 21								
ADG, lb	1.76	1.90	1.89	1.94	1.95	1.86	1.84	0.069
ADFI, lb	2.95	2.95	2.95	2.87	3.04	3.07	3.00	0.054
F/G	1.77	1.57	1.56	1.48	1.56	1.65	1.64	0.073
D 0 to 21								
ADG, lb	1.64	1.67	1.67	1.69	1.64	1.62	1.66	0.026
ADFI, lb	2.48	2.51	2.43	2.38	2.50	2.48	2.50	0.032
F/G	1.52	1.50	1.46	1.41	1.52	1.53	1.51	0.017

[a]A total of 280 pigs (five pigs per pen and eight pens per treatment) with an average initial BW of 30.9 lb.

Table 4. Probability Of Effects Of Fat Source From Corn Oil Or Ground Corn Germ On Nursery Pigs[a]

	P- Value			Corn oil		Ground Corn Germ	
Item	Fat level	Fat source	Level*Source	Linear	Quadratic	Linear	Quadratic
D 0 to 7							
ADG, lb	0.72	0.23	0.67	0.54	0.63	0.53	0.05
ADFI, lb	0.09	0.59	0.13	0.06	0.21	0.86	0.47
F/G	0.005	0.03	0.45	0.28	0.02	0.48	0.01
D 7 to 14							
ADG, lb	0.44	0.22	0.36	0.81	0.90	0.77	0.17
ADFI, lb	0.04	0.23	0.06	0.008	0.56	0.77	0.46
F/G	0.02	0.02	0.15	0.07	0.90	0.47	0.39
D 14 to 21							
ADG, lb	0.59	0.54	0.34	0.12	0.51	0.70	0.20
ADFI, lb	0.29	0.008	0.88	0.37	0.50	0.47	0.18
F/G	0.44	0.02	0.11	0.03	0.50	0.50	0.31
D 0 to 21							
ADG, lb	0.39	0.03	0.78	0.22	0.72	0.82	0.60
ADFI, lb	0.07	0.04	0.13	0.005	0.15	0.87	0.95
F/G	0.002	<0.001	0.03	<0.001	0.39	0.77	0.42

[a]A total of 280 pigs (five pigs per pen and eight pens per treatment) with an average initial BW of 30.9 lb.