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The influence of dietary fat level and crystalline amino acid additions on growth performance of 25- to 50-lb pigs

Abstract

To determine the effects of increasing added fat on pig growth performance 1,440 pigs (each initially 26 lb) were used in a 21 d growth trial. Pigs were fed diets containing none, 1.5, 3.0, 4.5, and 6.0% choice white grease. Increasing added fat reduced (linear, P<0.05) ADFI and improved F/G. Although ADG was not significantly affected by fat level, increasing added fat from 0 to 1.5% or greater resulted in a 1-lb increase in total weight gain over the entire trial. The greatest improvement in feed efficiency was also observed with the addition of the first 1.5% fat; however, further increases in dietary fat continued to linearly reduce ADFI and improve F/G. These results would suggest that from 25 to 50 lb, 1.5 to 3.0% added fat optimized pig growth performance. Based on the results of Experiment 1, we conducted Experiment 2 to confirm the optimum level of added fat in combination with increased use of crystalline amino acids (3 vs 6 lb/ton L-lysine + other amino acids) to meet the pig's lysine requirements. In Experiment 2, 1,152 pigs (each initially 21 lb) were fed one of four dietary treatments arranged in a 2 x 2 factorial. Main effects included added fat (3 or 6%) and crystalline amino acid amounts (3 vs 6 lb/ton Llysine HCl with other amino acids added to maintain proper amino acid to lysine ratios). No differences were observed in growth performance, but based on current ingredient prices, reducing the amount of soybean meal by the use of higher levels of crystalline amino acids increased margin over feed cost. In conclusion, these data indicate that 3% added fat will optimize growth performance and margin over feed costs, and that the use of greater amounts of crystalline amino acids (up to 6 lb/ton L-lysine with added L-threonine and DL methionine) are efficiently used by the pig and will also help further increase margin over feed costs.; Swine Day, 2003, Kansas State University, Manhattan, KS, 2003

Keywords

Swine day, 2003; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 920; Kansas Agricultural Experiment Station contribution; no. 04-120-S; Pigs; Growth; Synthetic amino acids; Fat; Swine

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THE INFLUENCE OF DIETARY FAT LEVEL AND CRYSTALLINE AMINO ACID ADDITIONS ON GROWTH PERFORMANCE OF 25- TO 50-LB PIGS[1]

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Summary

To determine the effects of increasing added fat on pig growth performance 1,440 pigs (each initially 26 lb) were used in a 21 d growth trial. Pigs were fed diets containing none, 1.5, 3.0, 4.5, and 6.0% choice white grease. Increasing added fat reduced (linear, P<0.05) ADFI and improved F/G. Although ADG was not significantly affected by fat level, increasing added fat from 0 to 1.5% or greater resulted in a 1-lb increase in total weight gain over the entire trial. The greatest improvement in feed efficiency was also observed with the addition of the first 1.5% fat; however, further increases in dietary fat continued to linearly reduce ADFI and improve F/G. These results would suggest that from 25 to 50 lb, 1.5 to 3.0% added fat optimized pig growth performance. Based on the results of Experiment 1, we conducted Experiment 2 to confirm the optimum level of added fat in combination with increased use of crystalline amino acids (3 vs 6 lb/ton L-lysine + other amino acids) to meet the pig's lysine requirements. In Experiment 2, 1,152 pigs (each initially 21 lb) were fed one of four dietary treatments arranged in a 2 x 2 factorial. Main effects included added fat (3 or 6%) and crystalline amino acid amounts (3 vs 6 lb/ton L-lysine HCl with other amino acids added to maintain proper amino acid to lysine ratios). No differences were observed in growth performance, but based on current ingredient prices, reducing the amount of soybean meal by the use of higher levels of crystalline amino acids increased margin over feed cost. In conclusion, these data indicate that 3% added fat will optimize growth performance and margin over feed costs, and that the use of greater amounts of crystalline amino acids (up to 6 lb/ton L-lysine with added L-threonine and DL methionine) are efficiently used by the pig and will also help further increase margin over feed costs.

(Key Words, Pigs, Growth, Synthetic Amino Acids, Fat)

Introduction

Previous studies have demonstrated the positive response to adding increasing amounts of fat to growing and finishing pig diets. However, there has been some concern that nursery pigs do not show the same response as finishing pigs to high levels of fat. In diets fed immediately after weaning, high levels of fat are used only to aid in the pelleting process to prevent burning and scorching

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[2]Food Animal Health and Management Center.
[3]Ajinomoto Heartland LLC, Chicago, Illinois.

of the milk products. In the later nursery stages, protein deposition may be limited by energy intake. High levels of fat in the diet are used to improve lean gain. In addition to the energy density of the diet, we have also recently observed an increase in dietary lysine requirements of pigs fed from 13 to 45 lb. In these experiments, diets contained greater amounts crystalline amino acids than used in the past (up to 6 lb/ton with added L-threonine and DL methionine). The purpose of Experiment 1 was to determine the ideal level of fat to add to diets for 25- to 50-lb pigs for optimal performance and economics. Experiment 2 was to confirm the results of Experiment 1 in conjunction with increased dietary lysine concentrations observed in previous studies.

Procedures

A total of 1,440 pigs (each initially 26 lb) was used in a 21-d growth trial to determine the effects of increasing added fat on pig growth performance. Pigs were housed in a commercial nursery in southern Minnesota and fed diets containing none, 1.5, 3.0, 4.5, and 6.0% choice white grease (Table 1). Each diet was formulated using the same true ileal digestible lysine:Kcal ME ratio. Experimental diets met or exceeded the nutrient requirement estimates suggested by the National Research Council (NRC; 1998). There were 60 pens (30 of barrows and 30 of gilts) with 24 pigs per pen. All pigs were phase fed the same SEW, Transition, and Phase II diets from weaning to d 21, when they were weighed and randomly assigned to their experimental diets. Pigs were weighed and feed disappearance determined at the start of the study and on d 7, 14, and 21 to calculate ADG, ADFI, and F/G.

In Experiment 2, pigs were housed in the same nursery facility as in Experiment 1. However, there were only 48 pens used in the study, and each contained 24 pigs. The study was initiated 17 days after weaning when the pigs averaged 21.8 lb, and lasted 21 days. Pens of pigs were randomly allotted to one of four dietary treatments arranged in a 2 x 2 factorial (Table 2). Main effects included added fat (3 or 6%) and the amount of crystalline amino acids (3 or 6 lb/ton of L-lysine HCl with other amino acids added to maintain minimum ratios relative to lysine). Diets were formulated to contain either 1.50 or 1.56% total lysine for the 3 and 6% added fat treatments, respectively, thus maintaining a constant calorie:lysine ratio. In the diets containing 6 lb/ton L-lysine, approximately 90 lb of soybean meal was replaced by crystalline lysine and other amino acids compared with diets containing only 3 lb/ton of L-lysine.

Data in both trials were analyzed using the PROC MIXED procedures of SAS as a randomized complete block design, with two pens consuming feed from a single feeder as the experimental unit. Linear and quadratic effects of increasing dietary fat were evaluated in Experiment 1. Experiment 2 was as a 2 x 2 factorial with analysis of main effects and their interactions.

Results and Discussion

Increasing added fat in diets from 26 to 53 lb reduced (linear, $P<0.01$) ADFI and improved F/G. Although ADG was not significantly influenced by added fat, increasing the fat level from 0 to 1.5% or above resulted in approximately a 1-lb increase in total weight gain over the entire trial. The greatest improvement in feed efficiency was also due to the addition of the first 1.5% fat, although continued reductions in ADFI and improvements in F/G were observed.

As expected, adding fat increased diet cost approximately $4.00 for every 1.5% addition. Feed cost per pound of gain was not greatly influenced by the addition of fat; however, it was numerically increased as the fat level was increased above 1.5% of the diet. Previous recommendations have been to add 5 to 6% more fat to diets for pigs from 25 to 50 lb. This has been based on extrapolating results

observed with growing-finishing pigs that have observed linear responses in ADG and F/G up to 6% added fat. However, because in the present study there was no change in weight gain, it would appear that the amount of added fat could be lowered from 6% to at least 3%.

Based on results of this and previous experiments, we have recommended increasing lysine levels, lowered the fat level, and implemented use of more synthetic lysine and threonine. Therefore, the objective of Experiment 2 was to confirm the results of these changes in a single trial.

In Experiment 2, increasing added fat from 3 to 6% had no effect (P>0.10) on ADG, ADFI, or F/G. This was consistent with results of Experiment 1. Furthermore, pig growth performance was similar, whether the diets contained either 3 or 6 lb/ton of L-lysine HCl with other crystalline amino acids. This indicates that growing pigs efficiently utilized greater amounts of L-lysine HCl (6 lb/ton) as long as other crystalline amino acids were used to maintain proper ratios relative to lysine.

As expected, adding 6% fat increased diet cost compared to diets containing 3% added fat. Furthermore, based on current ingredient prices, the use of 6 lb/ton of L-lysine with additions of L-threonine and DL methionine increased diet cost relative to adding only 3 lb/ton of L-lysine. However, the relatively small changes in F/G resulted in very similar feed cost per lb of gain. This, combined with numerical increases in ADG of pigs fed the high crystalline amino acid-containing diets, actually resulted in slightly greater profitability than those diets containing 6% fat or more soybean meal. While the differences in pig growth performance were not significant, and ingredient prices may be variable, our data suggest that decreasing fat from 6 to 3% and using greater amounts of L-lysine HCl (6 lb/ton), with additions of L-threonine and DL methionine will not hurt pig growth performance.

Table 1. Experimental Diets, Experiment 1 (As-fed Basis)[a]

	Added Fat, %				
Ingredient, %	0	1.5	3	4.5	6
Corn	58.15	56.55	54.95	53.40	51.80
Soybean meal, 46.5% CP	37.90	37.90	37.90	37.90	37.90
Choice white grease	0.00	1.50	3.00	4.50	6.00
Dicalcium phosphate, 18.5% P	1.40	1.40	1.40	1.40	1.40
Limestone	0.75	0.75	0.75	0.75	0.75
Salt	0.35	0.35	0.35	0.35	0.35
Vitamin & trace mineral premix	0.30	0.30	0.30	0.30	0.30
Medication	0.70	0.70	0.70	0.70	0.70
L-Threonine	0.09	0.11	0.13	0.15	0.17
L-Lysine HCl	0.24	0.28	0.32	0.35	0.39
DL-Methionine	0.15	0.17	0.19	0.21	0.24
Total	100.0	100.0	100.0	100.0	100.0
Calculated analysis					
Total lysine, %	1.48	1.51	1.54	1.56	1.59
Isoleucine:lysine ratio, %	66	65	63	62	61
Leucine:lysine ratio, %	132	129	126	123	120
Methionine:lysine ratio, %	34	34	35	36	36
Met & Cys:lysine ratio, %	60	60	60	60	60
Threonine:lysine ratio, %	65	64	64	64	64
Tryptophan:lysine ratio, %	19	19	18	18	17
Valine:lysine ratio, %	73	72	70	68	67
ME, kcal/lb	1,483	1,512	1,542	1,572	1,601
Crude protein, %	22.6	22.4	22.3	22.2	22.0
Ca, %	0.73	0.72	0.72	0.72	0.72
P, %	0.68	0.68	0.67	0.67	0.67
Available P %	0.45	0.45	0.45	0.45	0.44
Lysine:calorie ratio, g/mcal	4.54	4.53	4.52	4.51	4.50
Avail P:calorie ratio g/mcal	1.37	1.34	1.31	1.28	1.26
True Digestible amino acids					
Lysine	1.34	1.36	1.39	1.42	1.44
Isoleucine:lysine ratio, %	65	64	62	61	59
Leucine:lysine ratio, %	132	128	125	122	118
Methionine:lysine ratio, %	35	36	36	37	38
Met & Cys:lysine ratio, %	60	60	60	60	60
Threonine:lysine ratio, %	62.6	62.5	62.5	62.5	62.4
Tryptophan:lysine ratio, %	19	18	18	18	17
Valine:lysine ratio, %	71	70	68	66	65
True dig lys:cal ratio	4.09	4.09	4.09	4.09	4.09

[a]Diets were fed from d 21 to 42 after weaning and nutrient profiles were calculated using ingredient values from NRC, (1998).

Table 2. Experimental Diets, Experiment 1 (As-fed Basis)[a]

	3% Fat		6% Fat	
Ingredient, %	High AA[b]	Low AA	High AA	Low AA
Corn	56.04	51.97	50.62	46.52
Soybean meal, 48% CP	37.04	41.37	39.44	43.81
Choice white grease	3.00	3.00	6.00	6.00
Dicalcium phosphate, 18.5% P	1.35	1.35	1.35	1.35
Limestone	0.70	0.70	0.70	0.70
Salt	0.35	0.35	0.35	0.35
Vitamin & trace mineral premix	0.30	0.30	0.30	0.30
Medication	0.70	0.70	0.70	0.70
L-Lysine HCl	0.30	0.15	0.30	0.15
L-Threonine	0.13	0.05	0.13	0.05
DL-Methionine	0.10	0.06	0.12	0.08
Total	100.0	100.0	100.0	100.0
Total lysine, %	1.50	1.50	1.56	1.56
ME, kcal/lb	1,545	1,549	1,606	1,610
Calcium, %	0.69	0.71	0.70	0.71
Phosphorus, %	0.66	0.68	0.66	0.68
Available phosphorus, %	0.33	0.34	0.33	0.34
Available phosphorus equiv, %	0.41	0.41	0.41	0.42
Lysine:calorie ratio, g/mcal	4.40	4.40	4.40	4.40
True Ileal digestible amino acids				
Lysine	1.36	1.35	1.41	1.40
Isoleucine:Lysine ratio, %	61	67	61	67
Leucine:lysine ratio, %	127	135	124	132
Methionine:lysine ratio, %	30	29	31	29
Met & Cys:lysine ratio, %	55	55	55	55
Threonine:lysine ratio, %	63	62	62	62
Tryptophan:lysine ratio, %	18	20	18	20
Valine:Lysine ratio, %	69	74	68	74

[a]Diets were fed from d 21 to 42 after weaning, and nutrient profiles were calculated using ingredient values from NRC, (1998).
[b]Low and High designate the amounts of crystalline amino acids added to each diet.

Table 3. Effect of Fat Level on Growth Performance and Diet Economics from 26 to 53 lb

	Added fat, %						P values		
Item	0	1.5	3.0	4.5	6.0	SEM	Fat	Linear	Quadratic
ADG, lb	1.24	1.29	1.29	1.28	1.28	0.02	0.56	0.27	0.27
ADFI, lb	1.96	1.93	1.89	1.84	1.81	0.024	0.001	0.001	0.92
F/G	1.57	1.49	1.47	1.43	1.41	0.014	0.001	0.001	0.11
Diet cost, $/ton	150.00	154.40	158.80	163.20	167.60				
Feed cost/lb of gain, $	$0.117	$0.115	$0.116	$0.116	$0.117				
Total wt gain, lb	26.1	27.0	27.0	26.9	26.9				
Feed cost for 27 lb of gain, $/pig	$3.17	$3.11	$3.13	$3.14	$3.16				

Table 4. Effects of Added Fat Level and Crystalline Amino Acid Additions on Growth Performance and Feed Costs in 21- to 45-lb Pigs[a]

	3% Fat		6% Fat		
Ingredient, %	High AA[b]	Low AA	High AA	Low AA	SE
Initial wt, lb	21.83	21.85	21.85	21.87	0.31
ADG, lb	1.13	1.10	1.12	1.11	0.03
ADFI, lb	1.63	1.62	1.60	1.58	0.04
F/G	1.45	1.48	1.44	1.44	0.03
Final wt, lb	45.6	44.9	45.5	45.1	0.60
Diet cost, $/ton	158.10	156.17	167.69	165.79	
Total feed cost $/pig	2.71	2.65	2.81	2.75	
Feed cost, $/lb gain	0.114	0.115	0.119	0.118	
Margin over feed cost, $	6.80	6.57	6.65	6.54	
Difference, $[c]	0.25	0.03	0.11	-	

[a]Each value represents the mean of 6 observations, with 2 pens and a single fenceline feeder per observation. There were 24 pigs per pen.
[b]No differences (P>0.10) were observed among treatment means.
[c]Difference represents the change in margin over feed cost compared with pigs fed the least profitable dietary treatment.