EFFECTS OF INCREASING CRYSTALLINE LYSINE AND DIETARY FAT ON FINISHING PIG GROWTH PERFORMANCE[1]

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Summary

A total of 1,024 barrows (each initially 157 lb, PIC L337 x C22) were used in a 28-d study to evaluate the effects of increased crystalline amino acids (none versus 4.5 lb/ton of L-lysine HCl plus L-threonine to maintain the proper ratio relative to lysine) and added dietary fat (none, 3 or 6% choice white grease) on finishing pig growth performance. All experimental diets were formulated with a constant true ileal digestible lysine:ME ratio based on NRC, (1998) ingredient values for ME. A minimum true ileal digestible threonine:lysine ratio of 68% and a minimum true ileal digestible methionine + cystine:lysine ratio of 55% were used in diet formulation. There was no synthetic amino acid by added fat interactions. Increasing added fat increased (linear, P<0.01) ADG and improved F/G. Replacing soybean meal with crystalline amino acids had no affect on growth performance. This indicates that the increased amounts of L-lysine HCl and added L-threonine were used as efficiently as amino acids provided from soybean meal. Neither adding fat nor crystalline lysine affected feed cost/lb of gain using current ingredient prices. However, margin over feed cost (profit) increased as added fat increased because of the increased pig weight due to improved ADG. In summary, these results confirm the improved ADG and F/G when adding fat to finishing pig diets. Furthermore, 4.5 lb/ton of L-lysine HCl and L-threonine can effectively replace soybean meal without negatively affecting growth performance of pigs from 157 to 217 lb.

(Key Words: Finishing Pigs, Growth Performance, Fat, Amino Acids)

Introduction

Adding fat to finishing pig diets has been shown to increase ADG and improve F/G with the growth response to added fat appearing to decrease after pigs weigh approximately 200 to 220 lb. Adding fat to swine diets typically increases diet cost, and in many cases also increases feed cost per lb of gain. However, if a production system works on a fixed time basis (i.e., only so many days before all pigs must be sold and room made for the next group of pigs), then increasing ADG by adding fat may actually increase profitability by selling more total pounds of pork over the same time period. Thus, even though fed cost per lb of gain increases with added fat, margin over feed costs (profit) also may increase.

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Use of synthetic amino acids in finishing diets has often been limited to 3 lb of L-lysine HCl per ton of feed because inclusion of higher levels reduces performance unless other amino acids are also added to the diet. The second limiting amino acid, L-threonine, was too expensive for routine addition before the opening of a new threonine production plant in the last year. With the new plant on line, practical application of higher levels of L-lysine HCl along with the L-threonine additions to replace soybean meal must be tested.

This experiment had two objectives: the first was to evaluate the effects of increasing added fat on finishing pig growth performance and economics. The second was to compare growth performance of pigs fed either none, or 4.5 lb/ton of L-lysine HCl and L-threonine as a replacement for soybean meal in the diet.

Procedures

A total of 1,024 barrows (each initially, 157 lb, PIC L337 x C22) was used in a 28-d study. Pigs were fed one of six experimental diets arranged in a 2 x 3 factorial (Table 1). Main effects included crystalline amino acid addition (none vs 4.5 lb/ton of L-lysine HCl plus L-threonine to maintain the proper ratio relative to lysine) and added dietary fat (none, 3 or 6% choice white grease). All experimental diets were formulated with a constant true ileal digestible lysine:ME ratio based on NRC, (1998) ingredient values for ME. A minimum true ileal digestible threonine:lysine ratio of 68% and a minimum true ileal digestible methionine + cystine:lysine ratio of 55% were used in diet formulation. There were 24 or 25 pigs per pen and seven pens (observations) per treatment. Pens of pigs and feeders were weighed at the start of the study and on days14 and 28 to calculate ADG, ADFI, and F/G.

Data were analyzed using the PROC MIXED procedures of SAS as a randomized complete block design with pen as the experimental unit. Main effects of added L-lysine HCl, added fat, and their interactions were evaluated. Linear and quadratic effects of increasing dietary fat were also determined.

Results and Discussion

There was no added synthetic amino acid by added fat interaction observed ($P>0.10$; Table 2 and 3). Increasing added fat increased (linear, $P<0.01$) ADG and improved F/G. Increasing added fat also increased (linear, $P<0.01$) average pig weight at the end of the 28-d study. Increasing added crystalline amino acids (none vs 4.5 lb/ton of L-lysine HCl plus other crystalline amino acids to maintain the proper ratio relative to lysine) had no affect on growth performance, suggesting that the increased use of L-lysine HCl with added L-threonine could be used as efficiently as amino acids provided from soybean meal. It is important to point out that minimum ratios of true ileal digestible threonine: lysine ratio (68%) was relatively high compared with other threonine requirement estimates but was slightly below the threonine: lysine ratio of the diets containing no added L-lysine HCl. Neither adding fat nor crystalline lysine affected feed cost/lb of gain using current ingredient prices. However, margin over feed cost (profit) increased as added fat increased because of the increased pig weight due to improved ADG.

In summary, these results confirm the improved ADG and F/G when adding fat to finishing pig diets (157 to 217 lb). In production systems that operate on a fixed time basis, the increased ADG can result in greater profitability as more pounds of pork can be sold within the same amount of time. Furthermore, 4.5 lb/ton of L-lysine HCl and L-threonine can effectively replace soybean meal without negatively affecting pig growth performance. Depending on ingredient prices, this substitution may lower diet cost and reduce nitrogen excretion in swine waste.

Table 1. Composition of Experimental Diets

	Added L-lysine HCl, lb/ton					
	0			4.5		
	Added Fat, %					
Ingredient, %	0	3	6	0	3	6
Corn	76.35	71.95	67.50	83.10	78.70	74.30
Soybean meal, 46.5%	21.15	22.55	24.00	14.05	15.50	16.90
Choice white grease	---	3.00	6.00	---	3.00	6.00
Monocalcium phosphate, 21% P	1.05	1.05	1.05	1.10	1.08	1.08
Limestone	0.93	0.93	0.93	0.93	0.93	0.93
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix with phytase	0.06	0.06	0.06	0.06	0.06	0.06
Trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
L-Threonine	---	---	---	0.08	0.08	0.09
Lysine HCl	---	---	---	0.23	0.23	0.23
	100.00	100.00	100.00	100.00	100.00	100.00
True dig lysine:ME ratio	2.193	2.191	2.193	2.193	2.192	2.191
Total lysine, %	0.84	0.87	0.90	0.82	0.85	0.88
True ileal digestible amino acids,%						
Lysine	0.73	0.76	0.79	0.73	0.76	0.79
Isoleucine:lysine ratio	81	80	79	65	65	64
Leucine:lysine ratio	190	183	177	167	161	156
Methionine:lysine ratio	34	33	32	29	28	28
Met & Cys:lysine ratio	69	67	65	60	59	57
Threonine:lysine ratio	72	70	69	68	68	68
Tryptophan:lysine ratio	22	22	22	17	17	17
Valine:lysine ratio	93	91	90	77	76	75
ME, kcal/lb	1,509	1,570	1,632	1,505	1,567	1,628
Modified ME, kcal/lb	1,446	1,507	1,569	1,450	1,511	1,572
Protein, %	16.3	16.6	16.9	13.6	13.9	14.2
Ca, %	0.64	0.64	0.65	0.63	0.63	0.63
P, %	0.58	0.58	0.58	0.56	0.55	0.55
Available P, %	0.31	0.31	0.31	0.31	0.31	0.31

Table 2. Effects of Added Fat and Crystalline Lysine on Performance of 155-to 215-lb Barrows Raised in a Commercial Environment[a,b]

	Added L-lysine HCl, lb / ton												
	0			4.5					Probability (P>)				
	Added Fat, %											Fat	Lysine
Item	0	3	6	0	3	6	SED	SED	Lysine	Fat	Linear	Quadratic	x fat
Initial wt, lb	156.7	157.8	156.9	157.0	158.8	157.6	1.19	0.85	0.34	0.22	0.67	0.09	0.91
ADG, lb	2.06	2.11	2.14	1.92	2.12	2.16	0.06	0.04	0.30	0.002	0.001	0.24	0.15
ADFI, lb	6.30	6.20	6.05	6.11	6.19	6.14	0.09	0.06	0.50	0.19	0.10	0.46	0.12
F/G	3.05	2.95	2.83	3.18	2.91	2.85	0.08	0.05	0.41	0.001	0.001	0.32	0.35
Final wt, lb[c]	215.3	216.7	217.5	211.4	216.9	218.0	1.75	1.24	0.29	0.003	0.001	0.26	0.15
Feed cost/lb of gain, $[d]	0.184	0.186	0.187	0.189	0.182	0.186	0.005	0.003	0.98	0.66	0.86	0.38	0.40
IOMFC[e], $	11.34	11.53	11.58	10.32	11.78	11.74	0.58	0.42	0.55	0.09	0.06	0.26	0.25

[a]A total of 1,024 barrows (PIC L337 x C22) in 42 pens was used in a 2 (levels of added crystalline lysine) x 3 (levels of added fat) factorial design to evaluate the effects of increasing added fat and crystalline lysine.
[b]Threonine:lysine ratios were held to a minimum of 68%.
[c]Calculated end weight used initial weight as a covariate.
[d].Commodity prices of $ 2.40/bu corn, $ 180/ton SBM, $0.12/lb CWG, $ 0.76/lb lys; $1.20/lb thr.
[e]IOMFC, Income over marginal feed costs, = (Live price ($38CWT) × (calc wt 28 - wt 0)) - (adg × 28 days × feed cost/lb of gain).

Table 3. Main Effects of Added Fat and Crystalline Lysine on Performance of 155- to 215-lb Barrows Raised in a Commercial Environment[a,b]

	Main Effects							Probability (P>)				
	L-Lysine HCl, lb/ton			Added fat, %						Fat		Lysine
Item	0	4.5	SED	0	3	6	SED	Lysine	Fat	Linear	Quadratic	x fat
Initial wt, lb	157.1	157.8	0.69	156.9	158.3	157.2	0.85	0.34	0.22	0.67	0.09	0.91
ADG, lb	2.11	2.07	0.04	1.99	2.12	2.15	0.04	0.30	0.002	0.001	0.24	0.15
ADFI, lb	6.18	6.15	0.05	6.21	6.19	6.09	0.06	0.50	0.19	0.10	0.46	0.12
F/G	2.94	2.98	0.04	3.12	2.93	2.84	0.05	0.41	0.001	0.001	0.32	0.35
Final wt, lb[c]	216.5	215.4	1.01	213.4	216.8	217.71	1.24	0.29	0.003	0.001	0.26	0.15
Feed cost/lb of gain, $[d]	0.186	0.186	0.003	0.186	0.184	0.187	0.003	0.98	0.66	0.86	0.38	0.40
IOMFC[e], $	11.48	11.28	0.34	10.83	11.66	11.66	0.42	0.55	0.09	0.06	0.26	0.25

[a]A total of 1,024 barrows (PIC L337 x C22) in 42 pens was used in a 2 (levels of added crystalline lysine) x 3 (levels of added fat) factorial design to evaluate the effects of increasing added fat and crystalline lysine.
[b]Threonine:lysine ratios were held to a minimum of 68%.
[c]Calculated end weight used initial weight as a covariate.
[d.]Commodity prices of $ 2.40/bu corn, $ 180/ton SBM, $0.12/lb CWG, $ 0.76/lb lys; $1.20/lb thr.
[e]IOMFC, Income over marginal feed costs, = (Live price ($38CWT) × (calc wt 28 - wt 0)) - (adg × 28 days × feed cost/lb of gain).