EFFECTS OF INCREASING CRYSTALLINE LYSINE WITH OTHER AMINO ACIDS ON GROWTH PERFORMANCE OF 85- TO 135-LB GILTS[1]

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Summary

A total of 1,134 gilts (each initially 85 lb, PIC L337 x C22) was used in a 28-d experiment to evaluate the effects of replacing soybean meal with up to 8 lb/ton of crystalline L-lysine HCl with other crystalline amino acids on growth performance. Gilts were randomly allotted to one of six experimental diets. Diets were corn-soybean meal-based with 3% added fat. Diets included a negative control containing 3 lb/ton of L-lysine HCl and formulated to 0.90% true ileal digestible lysine. Two additional diets were formulated with 3 lb/ton L-lysine to 1.0% true ileal digestible lysine but with or without crystalline threonine and methionine to compare threonine to lysine ratios of 60 versus 65% and methionine & cystine (TSAA) ratios of 55 vs. 60%. The three remaining diets contained 6, 7, or 8 lb/ton of L-lysine HCl with crystalline threonine and methionine to provide the same ratios relative to lysine of 65 and 60%, respectively.

Pigs fed the negative control diet (0.90 true ileal digestible lysine) had decreased ADG, poorer F/G, and were lighter at then end of the trial than pigs fed the diet containing 3 lb/ton L-lysine with added L-threonine and DL methionine (P<0.05). This indicates that diets containing 1.0% true ileal digestible lysine were not over the pigs' lysine requirement. Pigs fed 1.0% true ileal digestible lysine with high threonine and TSAA ratios (65 and 60% relative to lysine, respectively) had similar ADG but tended to have better (P<0.08) F/G than those fed the lower threonine and TSAA ratios. Using 6, 7, or 8 lb/ton of L-lysine HCl with added threonine and methionine in diets formulated to 1.0% true ileal digestible lysine had no effect on ADG or F/G, but did tend to decrease ADFI (linear, P<0.04; quadratic P<0.07). These results suggest that the use of up to 8 lb/ton of L-lysine HCl in conjunction with L-threonine and DL methionine to maintain proper amino acid to lysine ratios will not negatively affect pig performance. In addition, increasing the true ileal digestible threonine:lysine (60 to 65%) and TSAA:lysine ratios (55 to 60%) improved F/G in this experiment.

(Key Words: Crystalline Amino Acids, Growing Pigs, Performance)

Introduction

Last year the first commercial production facility dedicated to L-threonine production was opened in the United States. As a result,

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L-threonine has become more widely available and less expensive for use in swine diets. If economically feasible, the use of L-threonine would allow for greater amounts of L-lysine to be used than the typical 3 lb/ton inclusion and less soybean meal. This will have environmental advantages by further decreasing nitrogen concentration in swine waste by another 20% compared with adding 3 lb/ton L-lysine alone. However, the key to adding greater than 3 lb/ton of L-lysine and other amino acids is an understanding of the correct amino acid ratios relative to lysine so deficiencies do not result in poorer pig growth performance. Therefore, the objective of this study was to evaluate the effects of increasing L-lysine HCl in finishing pig diets held at a constant percentage of true ileal digestible lysine (1.0%).

Procedures

A total of 1,134 gilts (each initially 85 lb, PIC L337 x C22) was used in a 28-d experiment. There were a total of 42 pens with 27 pigs per pen, 7 pens (observations) per treatment. Pens of gilts were randomly allotted to one of six experimental diets (Table 1). Diets were corn-soybean meal-based with 3% added fat and included a negative control containing 3 lb/ton of L-lysine HCL and formulated to 0.90% true ileal digestible lysine. Two additional diets were formulated with 3 lb/ton L-lysine to 1.0% true ileal digestible lysine but with or without crystalline threonine and methionine. This provided a comparison of threonine to lysine ratios of 60 and 65%, and methionine and cystine (TSAA) ratios of 55 and 60%. The three remaining diets contained 6, 7, or 8 lb/ton of L-lysine HCl, with crystalline threonine and methionine to provide the same ratios relative to lysine of 65 and 60%, respectively. Pigs and feeders were weighed on d 0, 14, 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. Pen was the experimental unit. Contrasts were used to compare pigs fed the negative control diet (0.90% true ileal digestible lysine) to the mean of pigs fed the 1.0% true ileal digestible lysine diet from 3 lb/ton L-lysine HCl. Also, threonine and TSAA ratios of 60 and 65% and 55 and 60%, respectively were compared. Finally, linear and quadratic effects of increasing L-lysine HCl were evaluated.

Results and Discussion

An important experimental consideration when conducting studies designed to determine the correct ratio of amino acids relative to lysine, or evaluating high inclusion rates of L-lysine HCl on pig growth is that the experimental diets are not formulated above the pigs' lysine requirement. If diets happen to be above the pigs' requirements, it is possible that concentrations of other amino acids are also above their requirements. If this were the case, we would erroneously assume efficient utilization of high levels of L-lysine HCl, as pigs would have similar performance as controls. To verify that our experimental true ileal digestible lysine concentration of 1.0% was not too high, we fed pigs a negative control diet containing 0.90% true ileal digestible lysine. Pigs fed the negative control diet (0.90 true ileal digestible lysine) had decreased ADG, poorer F/G, and were lighter at then end of the study than pigs fed the diet containing 3 lb/ton L-lysine with added L-threonine and DL methionine ($P<0.05$). This indicates that diets containing 1.0% true ileal digestible lysine were not over the pigs' lysine requirement.

Pigs fed 1.0% true ileal digestible lysine with high threonine and TSAA ratios (65 and 60% relative to lysine, respectively) had similar ADG but tended to have better ($P<0.08$) F/G than those fed the lower threonine and TSAA ratios. Using 6, 7, or 8 lb/ton of L-lysine HCl with added threonine and methionine in diets formulated to 1.0% true ileal di-

gestible lysine had no effect on ADG or F/G, but did tend to decrease ADFI (linear, $P<0.04$; quadratic $P<0.07$). These results suggest that the use of up to 8 lb/ton of L-lysine HCl in conjunction with L-threonine and DL methionine to maintain proper amino acid to lysine ratios will not negatively affect pig performance.

In conclusion, the use of up to 8 lb/ton of L-lysine combined with L-threonine and DL-methionine appears to be an effective substitution for soybean meal in diets for pigs from 85 to 130 lb. Depending on ingredient costs, replacing soybean meal with crystalline amino acids may lower diet cost. It will also have an environmental impact, as swine waste will contain less nitrogen.

Table 1. Experimental Diet Composition (As-fed Basis)

	Added L-Lysine HCl lb/ton					
	3	3	3	6	7	8
	True Ileal Digestible Lysine, %					
	0.90	1.0	1.0	1.0	1.0	1.0
	TSAA:Lysine Ratio, %					
	60	60	55	60	60	60
	Threonine:Lysine Ratio, %					
	65	65	60	65	65	65
Corn	70.32	66.35	66.46	70.72	72.16	73.64
Soybean meal, 46.5%	23.52	27.50	27.49	22.83	21.30	19.74
Choice white grease	3.00	3.00	3.00	3.00	3.00	3.00
Monocalcium P, 21% P	1.35	1.30	1.30	1.35	1.35	1.35
Limestone	1.05	1.05	1.05	1.05	1.05	1.05
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix with phytase	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
Copper sulfate	0.03	0.03	0.03	0.03	0.03	0.03
L-threonine	0.04	0.05	---	0.11	0.14	0.16
Lysine HCl	0.15	0.15	0.15	0.30	0.35	0.40
DL-methionine	0.03	0.05	---	0.09	0.11	0.12
Total	100.00	100.00	100.00	100.00	100.00	100.00
Total lysine, %	1.01	1.12	1.12	1.11	1.11	1.10
True ileal digestible amino acids, %						
Lysine	0.90	1.00	1.00	1.00	1.00	1.00
Isoleucine:lysine ratio	69	69	69	61	59	56
Leucine:lysine ratio	156	150	150	139	135	131
Methionine:lysine ratio	31	31	27	34	35	35
Met & Cys:lysine ratio	60	60	55	60	60	60
Threonine:lysine ratio	65	65	60	65	65	65
Tryptophan:lysine ratio	19	19	19	17	16	15
Valine:lysine ratio	79	77	77	70	67	64
ME, kcal/lb	1,560	1,559	1,561	1,555	1,554	1,553
Protein, %	16.9	18.4	18.4	16.6	16.0	15.4
Calcium, %	0.75	0.75	0.75	0.75	0.74	0.74
Phosphorus, %	0.64	0.65	0.65	0.64	0.63	0.63
Available P, %	0.39	0.38	0.38	0.39	0.38	0.38
Lysine:calorie ratio, g/mcal	2.94	3.26	3.26	3.23	3.23	3.22
Avail P:calorie ratio g/mcal	1.13	1.11	1.11	1.13	1.12	1.12

Table 2. Effects of Increasing Crystalline Lysine with Other Amino Acids on Growth Performance of 85- to 135-lb Gilts

	Added L-Lysine HCl lb/ton											
	3	3	3	6	7	8						
	True Ileal Digestible Lysine, %											
	0.90	1.0	1.0	1.0	1.0	1.0						
			TSAA:Lysine Ratio, %									
	60	60	55	60	60	60						
	Threonine:Lysine Ratio, %							Model	Contrasts[d], P <			
Item	65	65	60	65	65	65	SED	P <	1	2	3	4
Initial wt, lb	85.2	85.1	85.2	85.5	85.1	85.2	0.73	0.99	0.90	0.99	0.67	0.97
ADG, lb	1.79	1.92	1.88	1.93	1.91	1.87	0.04	0.03	0.01	0.39	0.20	0.40
ADFI, lb	3.86	3.98	3.97	3.99	3.92	3.80	0.07	0.09	0.11	0.04	0.07	0.40
F/G, lb	2.17	2.08	2.11	2.06	2.05	2.04	0.04	0.03	0.09	0.27	0.84	0.08
Final wt, lb	135.3	138.9	137.8	139.3	138.8	137.5	1.23	0.04	0.01	0.40	0.23	0.42
Feed cost/lb of gain, $[c]	0.143	0.142	0.142	0.141	0.140	0.139	0.003	0.80	0.66	0.37	0.84	0.55
IOFC, $/hd[c]	13.03	14.04	13.78	14.16	14.12	13.67	0.38	0.06	0.01	0.51	0.25	0.48

[a]A total of 1,134 gilts (PIC L337 x C22) with 27 pigs per pen was used.
[b]28-day weights, adjusted to a common start weight.
[c]Feed cost and income over feed cost (IOFC) were calculated using $ 2.40 / bu corn, $180/ton 46.5% SBM, $0.76/lb Lysine, $1.20/lb Methionine, $ 1.20/lb threonine.
[d]Contrasts: 1=0.90 true ileal digestible lysine vs 1.0 true ileal digestible lysine with 3 lb of added lysine and 65% Threonine:Lysine ratio. 2 = linear effect of increasing L-lysine HCl. 3 = quadratic effect of increasing L-lysine HCl. 4 = TSAA ratio of 55 vs 60% in diets with 1.0% true ileal digestible lysine.