EFFECT OF METHIONINE:LYSINE RATIO ON GROWTH PERFORMANCE AND BLOOD METABOLITES OF GROWING-FINISHING PIGS[1]

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Summary

Eighty growing-finishing pigs (40 barrows and 40 gilts) were used in three consecutive growth assays to determine the optimum methionine:lysine ratio for pigs weighing from 48 to 107 lb, 120 to 179 lb, and 191 to 245 lb, respectively. Each growth assay was to be conducted for a 28-d period with a 14-d transition period between assays. Pigs were allotted by weight and placed in pens each containing one barrow and one gilt. Pigs were assigned to one of eight experimental treatments with five replicate pens per treatment. Pigs were fed diets containing either high lysine (1.0, .9, or .8%, respectively) or low lysine (.8, .7, or .6%, respectively) with dietary methionine at 24.5, 28, 31.5, or 35% of lysine. This would correspond to total sulfur-containing amino acids (methionine + cystine) of 49, 56, 63, and 70% relative to lysine. During the first study (48 to 107 lb), average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F/G) improved with increasing dietary lysine. Although no differences occurred in growth performance with increasing methionine ratio, there was a numeric improvement in growth performance for those pigs receiving diets containing 28% methionine relative to lysine. A lysine × methionine interaction was observed for blood urea N with pigs having the lowest BUN values observed with methionine at 24.5 and 31.5% of lysine for pigs fed .8 and 1.0% lysine, respectively. During phase II (120 lb to 179 lb), ADG improved with increasing dietary lysine and showed a linear response to increasing methionine ratio. Feed efficiency was also improved with increasing dietary lysine. For the third phase (191 to 245 lb), ADG also improved with increasing dietary lysine. There were no significant differences in feed intake; however, feed efficiency improved with increasing dietary lysine. In summary, because of high ADFI observed in these studies, the dietary methionine levels used closely met or exceeded the pig's requirement on a grams/day basis. Therefore, these data suggest that increasing dietary methionine does not improve pig performance.

(Key Words: Lysine, Methionine, Growth Performance, Growing-Finishing.)

Introduction

Previous research has attempted to determine the optimum ratio at which methionine is in accordance to lysine, which is typically the first limiting amino acid in swine diets. Recent research has suggested that the ratio may be as high as 70% total sulfur-containing amino acids, whereas others have suggested that the ratio is closer to 63%. Both of the ratios are higher than currently suggested by the ARC (1981) and NRC (1988). When attempting to determine the appropriate methionine level, most experiments have used a constant lysine level; however, the methionine requirement may be affected when the lysine level is

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changed. Also, as the pig matures, the ratio of other amino acids relative to lysine may vary. Thus, the objective of this experiment was to determine the optimum ratio of methionine to lysine for pigs weighing approximately 48 to 107 lb, 120 to 179 lb, and 191 to 245 lb and fed two levels of dietary lysine.

Procedures

Eighty Duroc × (Yorkshire × Hampshire) pigs (40 barrows and 40 gilts) were used in three consecutive growth assays to determine if the ratio of methionine to lysine changes as the lysine level of the diet is changed and as the pig matures. Pigs were allotted by weight and ancestry to pens containing 1 barrow and 1 gilt. Pigs were assigned to one of eight dietary treatments in 2 × 4 factorial design. Pigs were housed in an environmentally controlled finishing barn with ad libitum access to feed and water with a single hole feeder and one nipple waterer. Diets contained either 1.0 or .8% lysine and methionine in ratio to lysine at either 24.5, 28, 31.5, or 35%. During phase I of the experiment, pigs were started at an average initial weight of 48 lbs. Pigs were used in phase I for 28 days, at which time they were reallotted. After a 14-d adjustment period, pigs were switched to phase II of the experiment. Pigs were started on phase II at an average initial weight of 120 lbs. Pigs received diets containing either .9 or .7% lysine with methionine in ratio to lysine the same as in the first experiment. Pigs were kept on phase II of the experiment for 28-d, at which time they were again reallotted by weight and allowed a 14-d transition period before the initiation of phase III. During phase III, pigs received diets that were formulated to contain either .8 or .6% lysine with methionine in ratio to lysine in the same manner as in the first two phases. Pigs were kept on phase III of the experiment for 32-d. Pigs and feeders were weighed on d 14 and 28 of each phase to determine ADG, ADFI, and feed efficiency (F/G). Plasma samples were also taken from each pig on d 14 and 28 and analyzed for blood urea N content (BUN).

Results and Discussion

During phase I (48 to 107 lb), ADG ($P<.05$), ADFI ($P<.01$) and feed efficiency (F/G) ($P<.001$) showed significant responses to higher lysine diets. Pigs receiving the 1.0% lysine diet gained .10 lb/d more, consumed .20 lb/d more and were more efficient (1.86 vs 2.06) than those receiving the .8% lysine diet. There were no differences in pigs receiving the various ratios of methionine to lysine. However, there was a significant difference in BUN for each bleeding period, with significant lysine ($P<.001$), methionine ($P<.05$), and lysine by methionine ($P<.002$) responses for d 14 of the phase I period. Pigs receiving the diets containing .8% lysine had lower BUN than those fed 1.0% lysine. Pigs receiving the diet with methionine included at 24.5% of lysine had the lowest BUN for the .8% lysine diet, and those fed the 31.5% methionine:lysine diet for the 1.0% lysine had the lowest BUN. A similar pattern was seen for the d 28 bleeding of the phase I period. During phase II (120 to 179 lb), significant response to additional lysine and increasing methionine ratio occurred for ADG, ($P<.01$) and ($P<.05$), respectively. Pigs receiving diets containing .9% lysine gained .15 lb/d more, consumed .10 lb/d more feed, and were more efficient (2.78 vs 2.94) than those pigs receiving the .7% lysine diet. There also was a linear ($P<.02$) response to increasing the methionine ratio, with pigs receiving diets containing 31.5 and 35% methionine:lysine having the greatest ADG. Again, significant linear ($P<.07$) response in ADFI was observed for increasing methionine ratio. However, a significant response ($P<.01$) occurred only in feed efficiency with increased dietary lysine level. Blood urea nitrogen on d 14 and 28 increased ($P<.001$) with dietary lysine level and increasing methionine ($P<.02$), with both lysine levels having the lowest BUN value at the 24.5% level. During phase III (191 to 245 lb), ADG showed a significant improvement with increasing lysine level

(P<.001). There was also a quadratic response (P<.01) to increasing the ratio of methionine to lysine. Average daily gain decreased then increased as dietary methionine increased. No differences occurred in ADFI for the phase III period. However, feed efficiency was improved with increasing lysine level (P<.01). There was also a quadratic response (P<.03) in F/G, following a similar pattern to that of ADG. Blood urea nitrogen during the third phase was significantly increased (P<.001) with increasing lysine. For the third phase of the experiment, the lowest BUN was found for those pigs receiving the 28% methionine:lysine diet regardless of dietary lysine. In summary, because of high ADFI observed in these studies, the dietary methionine levels used closely met or exceeded the pig's requirement on a grams/day basis. Therefore, these data suggest that increasing dietary methionine does not improve pig performance.

Table 1. Composition of Basal Diets

	Dietary Lysine, %[a]				
Item, %	.6	.7	.8	.9	1.0
Corn	83.33	90.97	74.99	82.41	77.99
Soybean meal, 48% CP	-	1.07	8.61	9.90	14.43
Soybean oil	3.00	3.00	3.00	3.00	3.00
Monocalcium P, 21% P	1.98	1.85	1.83	1.69	1.61
Limestone	.94	.99	.91	.96	.94
Salt	.35	.35	.35	.35	.35
Vitamin premix	.20	.20	.20	.20	.20
Trace mineral premix	.15	.15	.15	.15	.15
Sugar[b]	8.84	.06	8.84	.075	.09
L-lysine-HCl	.46	.51	.41	.45	.422
Antibiotic[c]	.25	.25	.25	.25	.25
Choline chloride	.10	.10	.10	.10	.10
Cystine	.055	.096	.078	.085	.097
L-tryptophan	.067	.078	.053	.063	.06
L-isoleucine	.087	.096	.058	.064	.056
L-threonine	.16	.18	.18	.20	.205
Valine	.063	.063	.047	.054	.052
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis, %					
Digestible lysine	.50	.58	.67	.75	.84
Digestible methionine	.13	.14	.16	.18	.20
CP	7.25	8.43	10.25	11.9	13.8
Ca	.75	.75	.75	.75	.75
P	.65	.65	.65	.65	.65

[a]Pigs received 1.0 and .8% lysine diets (48 to 107 lb), .9 and .7% lysine diets (120 to 179 lb), .8 and .6% lysine diets (191 to 245 lb).
[b]Sugar was replaced by DL-methionine to provide the respective dietary methionine levels.
[c]Provide 50 g/ton Aureomycin.

Table 2. Effect of Methionine:Lysine Ratio on Growth Performance in Growing-Finishing Pigs Fed from 48 to 245 lb[a]

	Low Lysine[b]				High Lysine[c]				
Item	49	56	63	70	49	56	63	70	CV
48 to 107 lb									
ADG, lb[d]	2.05	2.12	1.90	2.14	2.21	2.23	2.10	2.08	7.77
ADFI, lb[e]	4.16	4.30	4.00	4.37	4.06	3.98	4.03	3.91	5.60
F/G[e]	2.03	2.04	2.12	2.05	1.84	1.79	1.93	1.89	6.52
120 to 179 lb									
ADG, lb[ef]	1.88	2.02	2.12	2.13	2.12	2.14	2.31	2.16	8.34
ADFI, lb[g]	5.72	5.79	6.27	6.06	5.94	6.00	6.39	5.98	6.23
F/G[e]	3.05	2.88	2.96	2.85	2.81	2.81	2.76	2.76	6.17
191 to 245 lb									
ADG, lb[eh]	1.85	1.45	1.65	1.70	1.98	1.75	1.99	1.98	10.71
ADFI, lb	6.78	6.45	6.40	6.34	6.80	6.49	6.71	6.92	9.10
F/G[ei]	3.67	4.50	3.95	3.75	3.42	3.77	3.36	3.51	11.51

[a]Eighty (40 barrows and 40 gilts) were used with 2 pigs/pen, 10 pens/treatment.
[b]Lysine levels used were .8% (48 to 107 lb),.7% (120 to 179 lb), and .6% (191 to 245 lb).
[c]Lysine levels used were 1.0% (48 to 107 lb),.9% (120 to 179 lb),and .8% (191 to 245 lb).
[d]Lysine response P<.05.
[e]Lysine response P<.01.
[f]Linear effect of methionine P<.02.
[g]Linear effect of methionine P<.07.
[h]Quadratic effect of methionine P<.01.
[i]Quadratic effect of methionine P<.03.

Table 3. Effect of Methionine:Lysine Ratio on Blood Urea Nitrogen in Growing-Finishing Pigs Fed from 48 to 245 lbs

	Low Lysine				High Lysine				
Item	49	56	63	70	49	56	63	70	CV
48 to 107 lb									
d 14 BUN[abcd]	3.7	4.2	5.6	4.6	17.3	12.2	8.7	11.1	32.7
d 28 BUN[ad]	3.4	4.5	7.1	5.6	15.9	14.6	11.1	14.2	30.2
120 to 179 lb									
d 14 BUN[acd]	6.3	17.7	7.4	7.4	16.9	17.4	18.9	21.8	28.5
d 28 BUN_{ac}	8.8	19.4	12.3	10.3	20.8	22.8	21.8	20.7	27.1
191 to 245 lb									
d 14 BUN[a]	12.6	11.1	13.1	10.9	20.8	16.7	19.8	19.4	15.0
d 28 BUN[a]	11.7	7.7	9.5	9.4	16.8	14.5	16.2	14.7	24.9

[a]Lysine response P<.001.
[b]Linear effect of methionine P<.01.
[c]Quadratic effect of methionine P<.10.
[d]Lysine × methionine interaction P<.01.