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Effects of Feeding Diets Formulated with Amino Acid Profiles Intended for High-, Medium-, and Low-lean Gain Pigs on the Performance of Medium-lean Gain Pigs

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Effects of feeding diets formulated with amino acid profiles intended for high-, medium-, and low-lean gain pigs on the performance of medium-lean gain pigs

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The University of Nebraska and South Dakota State University published a Swine Nutrition Guide with nutrient recommendations for pigs in a four-phase feeding system from 20 to 114 kg. The recommendations utilized the concepts of split sex feeding, ideal protein profile relative to lysine, and reduction of nitrogen excretion by lowering the total protein content of the diet with dietary supplementation with economically available amino acids. The research reported in this paper was an attempt to evaluate the consequences of feeding diets formulated for three lean growth genotypes to pigs of the medium-lean growth type.

(Key Words: Growing-finishing pigs, Lean-growth type, Phase feeding, Split-sex feeding.)

Experimental Procedure

Forty-eight barrows and 48 gilts initially weighing 20 kg were allotted four per pen to a 2 x 4 factorial arrangement of gender and amino acid regimen treatments within a complete block design. Pigs were sorted to three weight blocks within sex and randomly assigned to four treatments within each gender and weight block outcome group. One dietary treatment, control (CTL), was a diet formulated for high-lean growth gilts and fed to both genders. This diet met the lysine requirement of high-lean gilts without regard for excess amino acids and with no crystalline lysine supplementation. Three dietary treatments were amino acid regimens within gender as recommended by the Nebraska-South Dakota Nutrient Recommendations (1995) for pigs of high-lean (HLG), medium-lean (MLG), and low-lean (LLG) growth. These diets were reformulated to meet the nutrient requirements of each individual gender for four growth periods. They were grower I (20-36 kg), grower II (36-59 kg), finisher I (59-86 kg), and finisher II (86-114 kg). The diets were formulated to keep lysine, methionine, tryptophan, and threonine levels near the pigs' requirements, thus minimizing excesses of other amino acids. This involved supplementing all diets with crystalline lysine and some diets with crystalline methionine. The ideal protein ratios used for lysine: threonine: tryptophan: methionine-cystine: isoleucine were 100: 67: 18: 62: 60 for grower I and grower II and 100: 70: 19: 65: 60 for finisher I and finisher II. The lysine levels for HLG, MLG, and LLG gilts and HLG, MLG, and LLG barrows were (%) 1.00, .95, .92 and 1.00, .95 .92 for grower I; .93, .88, .84 and .88, .84, .79 for grower II; .87, .82, .74 and .74, .69, .62 for finisher I; and .69, .64, .56 and .60, .46, .50 for finisher II. Experimental diets for each gender and growth period are shown in Table 1. Since the requirements for barrows and gilts are considered to be the same from 20 to 36 kg, a common diet for each lean growth type was fed to both genders. For the other three phases, separate barrow and gilt diets were formulated. Pigs were housed on slatted floors in an environment-modified finishing barn and provided ad libitum feed and water intake. Diet changes were made for growth periods when pigs in individual pens averaged the upper weight in each growth phase as determined on weekly weigh days.

During the third week of the grower II period, blood was drawn from all pigs by vena cava puncture to obtain plasma urea nitrogen concentrations (PUN) as an indicator of protein utilization and excess nitrogen potentially excreted.

The experiment was analyzed as a randomized complete block design with gender, treatment, and block included in the model as main effects. The pen of pigs was considered the experimental unit.

Results

A summary of pig performance for each growth period and for the overall period is shown in Table 2. Only one interaction was found between gender and diet for the four phases of growth, but interaction means are presented to more clearly illuminate the results. Main effects,

TABLE 1. COMPOSITION OF EXPERIMENTAL DIETS (%)[a]

	Both	Gilts			Barrows		
Ingredients	CTR	HLG	LLG	LLG	HLG	MLG	LLG
Grower I							
Corn	68.17	73.16	75.37	76.20	73.16	75.37	76.20
Soybean meal, 44%	28.52	23.45	21.20	20.36	23.45	21.20	20.36
Dicalcium phosphate	1.20	1.30	1.35	1.37	1.30	1.35	1.37
Limestone	.87	.85	.84	.83	.85	.84	.83
Salt	.25	.25	.25	.25	.25	.25	.25
Premix[b]	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L-lysine HCl, g/ton[b]	0	1589	1680	1589	1589	1680	1589
DL methionine, g/ton[b]	91	454	182	182	454	182	182
Grower II							
Corn	71.04	76.23	78.99	81.20	78.99	81.20	83.40
Soybean meal, 44%	25.86	20.58	17.78	15.54	17.78	15.54	13.29
Dicalcium phosphate	.98	1.09	1.14	1.18	1.14	1.18	1.24
Limestone	.89	.86	.84	.84	.84	.84	.84
Salt	.25	.25	.25	.25	.25	.25	.25
Premix	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L-lysine HCl, g/ton	0	1635	1907	2134	1907	2134	2270
DL-methionine, g/ton	0	273	182	0	182	0	0
Finisher I							
Corn	73.54	77.60	80.95	84.27	84.27	87.03	90.34
Soybean meal, 44%	23.57	19.39	16.04	12.66	12.66	9.86	6.50
Dicalcium phosphate	.75	.84	.91	.97	.97	1.03	1.10
Limestone	.90	.88	.87	.85	.85	.84	.82
Salt	.25	.25	.25	.25	.25	.25	.25
Premix	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L-lysine HCl, g/ton	0	1317	1771	1862	1862	2134	2361
DL-methionine, g/ton	0	273	273	0	0	0	0
Finisher II							
Corn	80.48	87.33	89.54	92.30	90.92	89.54	95.06
Soybean meal, 44%	16.77	9.81	7.54	4.75	6.16	4.75	1.95
Dicalcium phosphate	.61	.76	.80	.86	.83	.86	.92
Limestone	.90	.87	.85	.84	.85	.84	.83
Salt	.25	.25	.25	.25	.25	.25	.25
Premix	1.00	1.00	1.00	1.00	1.00	1.00	1.00
L-lysine HCl, g/ton	0	2180	2270	2225	2225	2225	2361
DL-methionine, g/ton	0	0	0	0	0	0	0

[a]CTR = control (met protein requirement of high lean gilts at each stage of production), HLG = high lean gain, MLG = medium lean gain, and LLG = low lean gain (formulated using lysine and methionine supplementation to minimize excess amino acids while meeting the specific amino acid requirements of the lean gain type and sex at each stage of production).

[b]Provided per kg of complete diet: 100 mg ZN, 75 mg Fe, 7.5 mg Cu, 25 mg Mn, 175 :g I, 1300 :g SE, 16.5 IU vitamin E, 3.3 mg riboflavin, 17.6 mg niacin, 13.2:g vitamin B_{12}, 2.2 mg vitamin K_3, 13.2 mg pantothenic acid, 3960 IU vitamin A, and 396 IU vitamin D_3. Supplemental crystalline amino acids were added through the premix.

TABLE 2. GROWING-FIISHING PERFORMANCE OF MEDIUM LEAN GAIN BARROWS AND GILTS FED DIETS FORMULATED FOR PIGS OF THREE DIFFERENT LEAN GAIN POTENTIALS

	Diets[a] for lean gain potentials								
	Barrows				Gilts				
	CTR	HLG	MLG	LLG	CTR	HLG	MLG	LLG	SE
Grower I									
Initial wt, kg	25.1	24.7	24.3	24.6	23.7	24.2	24.3	24.2	.43
Final wt, kg	38.0	39.4	38.0	38.4	38.0	38.1	39.9	37.9	.60
Daily gain, kg	.65	.74	.69	.70	.66	.73	.73	.76	.04
Daily feed, kg	1.57	1.80	1.62	1.64	1.67	1.69	1.71	2.04	.16
Gain/feed	.42	.41	.42	.43	.40	.43	.43	.40	.02
Grower II									
Initial wt, kg	38.0	39.4	38.0	38.4	38.0	38.1	39.9	37.9	.60
Final wt, kg	62.6	64.5	61.4	63.0	62.4	61.2	62.2	62.0	1.67
Daily gain, kg	.78	.81	.66	.64	.83	.69	.77	.85	.07
Daily feed, kg	2.27	2.32	2.00	2.09	2.18	2.12	2.38	2.88	.25
Gain/feed	.34	.35	.33	.31	.39	.32	.32	.30	.03
PUN, mg/dL+[c]	13.6	10.7	11.7	10.0	13.1	10.6	8.7	9.5	.76
Finisher I									
Initial wt, kg	62.6	64.5	61.4	63.0	62.4	61.2	62.2	63.0	1.67
Final wt, kg	90.0	88.1	85.6	89.0	87.5	86.9	87.5	86.5	1.13
Daily gain, kg+	.89	.91	.81	.89	.80	.84	.84	.86	.08
Daily feed, kg	3.33	3.33	3.33	3.19	2.75	2.55	2.90	3.40	.25
Gain/feed	.27	.27	.24	.28	.29	.34	.29	.27	.03
Finisher II									
Initial wt, kg	90.0	88.1	85.6	89.0	87.5	86.9	87.5	86.5	1.13
Final wt, kg*	107.4	105.5	102.7	106.0	101.2	101.3	101.2	99.8	1.97
Daily gain, kg+[b]	.94	.91	1.01	.73	.86	.87	.77	.77	.05
Daily feed, kg+	3.72	3.95	3.64	2.82	3.18	2.85	3.12	3.82	.26
Gain/feed	.25	.23	.28	.24	.28	.31	.24	.22	.02
Overall									
Initial wt, kg	25.1	24.7	24.3	24.6	23.7	24.2	24.3	24.2	.02
Final wt, kg*	107.4	105.5	102.7	106.0	101.2	101.3	101.2	99.8	1.97
Daily gain, kg+	.82	.84	.76	.73	.79	.77	.78	.82	.04
Daily feed, kg[d]	2.72	2.80	2.59	2.43	2.42	2.27	2.52	3.03	.12
Gain/feed	.30	.30	.30	.30	.32	.34	.31	.28	.02

[a]CTR = control (met protein requirement of high lean gilts at each stage of production), HLG =- high lean gain, MLG = medium lean gain, and LLG = low lean gain (formulated using lysine and methionine supplementation to minimize excess amino acids while meeting the specific amino acid requirements of the lean gain type and sex at each stage of production).

+Gender effect (P<.10).

*Gender effect (P<.05).

[b]Diet effect (P<.10).

[c]Diet effect (P<.001).

[d]Diet x gender interaction (P<.05).

gender and diet (P<.10), are designated in the table. Pigs were removed from the test and marketed about midway through the finisher II period.

Gender effects (P>.10) were not evident for gain, feed intake, or gain/feed until the finisher I period. Barrows exhibited faster daily gain than gilts (P<.10) for the finisher I and finisher II periods. This resulted in greater gain for barrows (P<.10) for the overall period and barrows weighed 4.5 kg more than gilts at the termination of the experiment. Feed intake was greater (P<.10) for barrows than for gilts during the finisher II period. Overall, a gender effect for feed intake was not observed (P>.10). Gain/feed was not affected by gender (P>.10) for any growth period. A gender by diet interaction (P<.05) existed for the overall period; barrows increased and gilts decreased feed intake as amino acid levels were increased in the diets.

Pig performance was not affected (P>.10) by diets fed during the grower I, grower II, and finisher I periods. However, gain was affected by diet (P<.10) in the finisher II period. Pigs receiving the diet formulated for LLG pigs gained slower that those receiving diets formulated for HLG or MLG pigs, an indication that amino acid levels were not sufficient to support maximum growth and protein deposition. Feeding the diet formulated for HLG gilts on a protein basis (CTL) did not improve performance of barrows or gilts during any period. Concentrations of PUN during the grower II period suggest that many more amino acids were being deaminated and more nitrogen was being excreted when the diet was formulated on a protein rather than an ideal protein basis. The excesses of amino acids were neither harmful nor helpful to performance. These findings support research demonstrating performance of pigs is not improved by formulating diets on an ideal protein basis and that amino acids fed at levels higher than those needed for protein synthesis do not improve performance. However, two important factors were not addressed in this study, lean gain and nitrogen excretion.

Summary

Ninety-six barrows and gilts were utilized in a study to evaluate the effect of feeding diets formulated for HLG, MLG, and LLG pigs to pigs determined to be the MLG type. Diets were formulated for split sex feeding, supplemented with crystalline lysine and methionine where appropriate to minimize excess amino acids, and formulated on an ideal protein basis with amino acid ratios relative to lysine. In addition, a control group of pigs was evaluated utilizing diets formulated on a protein basis for high-lean gilts and fed to both barrows and gilts. Diets were reformulated for four growth periods, grower I (20-36 kg), grower II (36-59 kg), finisher I (59-86 kg), and finisher II (86-114 kg).

Gender effects were not evident for gain, feed intake, or gain/feed until the finisher I period. Barrows exhibited faster daily gain than gilts for the finisher I and II periods and weighed 4.5 kg more than gilts at the termination of the experiment. Feed intake was greater for barrows than for gilts during the finisher II period. Gain/feed was not affected by gender for any growth period.

Pig performance was unaffected by diets fed during the grower I, grower II, and finisher I periods. Pigs receiving the diet formulated for LLG pigs gained slower that those receiving diets formulated for HLG or MLG pigs in the finisher II period. A gender by diet interaction existed for the overall period for feed intake. Barrows increased and gilts decreased feed intake as amino acid levels were increased in the diets.

Feeding the diet formulated for HLG gilts on a protein basis (CTL) did not improve performance of barrows or gilts during any period. The excesses of amino acids were neither helpful nor harmful. During the finisher II period, pigs fed the diet formulated for LLG pigs exhibited reduced gain, an indication that amino acid levels were not sufficient to support maximum growth and protein deposition.

Implications

Feeding diets of varying concentrations of amino acids in an ideal protein ratio will not necessarily result in differences in gross production levels. Excess amino acids from high concentrations of an ideal protein or from excess protein is deaminated and the nitrogen is excreted as urea. Diets deficient in total amino acids may lead to a subtle depression in gain. The excretion of excess nitrogen associated with protein excesses and reduced protein lean deposition associated with protein deficiencies are not readily apparent when monitoring gain, feed intake, and gain/feed. It is important to know the genetic potential for the pigs being fed, because traditional measurements of performance are not going to indicate that potential. Differences in pig performance due to gender will be observed during the finishing period when gain and feed intake are greater for barrows. However, differences in amino acid requirements occur at an earlier stage.

The four-phase nutrient recommendations suggested in the Nebraska-South Dakota Swine Nutrition Guide (1995) provide maximum performance for medium-lean gain barrows and gilts fed gender-specific diets formulated on the basis of the tables for medium-lean gain pigs.