EFFECT OF INCREASED DIETARY LYSINE ON GROWTH PERFORMANCE OF GILTS FED RACTOPAMINE HCL (PAYLEAN[1]) IN A COMMERCIAL FACILITY

C. R. Neill, S. S. Dritz[2], M. D. Tokach, R. D. Goodband, J. L. Nelssen, J. M. DeRouchey, C. W. Hastad, and J. L. Usry[3]

Summary

A total of 1,915 gilts (PIC L337 × C22) were used in two 21-d experiments in a commercial research barn to evaluate the effects of lysine rates on pig growth and carcass performance when fed ractopamine HCl. There were 7 replicates per treatment and 21 to 24 pigs per pen in both experiments. In both experiments, treatments included a control diet formulated to 0.65% TID lysine without ractopamine HCl, and diets containing 0.75, 0.85, 0.95, 1.05, and 1.15% TID lysine with 5 ppm ractopamine. There were 983 (initially 217.4 lb) and 932 (initially 226.2 lb) gilts in Exp. 1 and 2, respectively. All diets were based on corn-soybean meal and contained high concentrations of synthetic amino acids (0.325% of L-lysine HCl with added threonine, methionine, and tryptophan) in Exp. 1, but only 0.075% L-lysine HCl in Exp. 2. As lysine increased in the diet, ADG increased and F/G decreased (linear; $P<0.05$), with the greatest response through 1.05% TID lysine in Exp. 1 and through 0.95% TID lysine in Exp. 2. In both experiments, pigs fed ractopamine HCl had increased ($P<0.003$) ADG and F/G, compared with performance of pigs fed the control diet. For carcass data, average backfat and FFLI were improved (linear; $P<0.03$) in Exp. 2 with increasing rates of TID lysine, but were not changed in Exp. 1. These experiments suggest that pigs fed ractopamine HCl require at least 0.95% or 26 g/d of TID lysine and at least 25 g of TID lysine/kg of gain.

(Key Words: Finishing Pig, Lysine, Ractopamine HCl.)

Introduction

Feeding ractopamine HCl to finishing pigs is a common practice in the swine industry. Elanco Animal Health (Indianapolis, IN) sells ractopamine HCl under their trade name Paylean. Ractopamine HCl is a synthetic compound in a class of compounds called phenethanolamines, which are not hormones or antibiotics. Numerous research trials have been conducted and have shown that pigs fed ractopamine have improved daily gain and feed efficiency. In previous research at Kansas State University, ADG improved 17 to 22% and F/G 12 to 20% when ractopamine HCl was fed. The growth response to ractopamine HCl can be limited if amino acid concentrations are not sufficient to support the increased lean gain. The lysine requirement is the greatest during the first few weeks that ractopamine HCl is fed because the pigs are growing the most rapidly during this time. There is only limited published research evaluating the ly-

[1]Paylean is a registered trademark of Elanco Animal Health, Indianapolis, IN.
[2]Food Animal Health and Management Center, College of Veterinary Medicine.
[3]Anjinomoto Heartland Lysine LLC, Chicago, IL.

sine requirement of pigs fed ractopamine HCl in a commercial facility. In the 2005 Swine Day report, we reported that pigs responded linearly to increasing TID lysine, indicating that more research is needed. Therefore, the objectives of these experiments were to determine the lysine requirement for gilts fed ractopamine HCl in a commercial barn for growth performance and carcass characteristics.

Procedures

General. All experimental procedures used in these studies were approved by the Kansas State University Animal Care and Use Committee.

A total of 983 (initially 217.4 lb) and 932 (initially 226.2 lb) gilts were used in Exp. 1 and 2, respectively. There were 7 replicates per treatment, and 21 to 24 pigs per pen in both experiments, which were conducted in a commercial research finishing barn in southwestern Minnesota and used similar genetics (PIC L337 × C22). Pens were 18 × 10 feet. The barns were double curtain sided, with completely slatted flooring and a deep pit for manure storage. Each pen contained one self-feeder and one cup waterer.

All diets were based on corn-soybean meal and contained high concentrations of synthetic amino acids (0.325% of L-lysine HCl, with added threonine, methionine, and tryptophan) in Exp. 1, but only 0.075% L-lysine HCl in Exp. 2. For both experiments, there were 6 dietary treatments, with 1 control diet formulated to 0.65%TID lysine without ractopamine HCl and 5 treatments formulated to contain 0.75, 0.85, 0.95, 1.05, and 1.15% TID lysine with 5 ppm of ractopamine. For all experiments, the lowest and highest concentration TID lysine dietary treatments were made and then were blended to produce the other dietary treatments.

Pigs from both experiments were weighed on d 0, 7, 14, and 21 to determine ADG, ADFI, and F/G. On d 21, pigs were individually tattooed by pen number and transported to Swift and Co. (Worthington, MN) for carcass data. Pens of pigs were kept together and weighed at the slaughter plant to figure shrink.

Statistical Analyses. In both experiments, treatments were arranged in a completely random design. Analysis of variance was conducted on all data by using the MIXED procedure of SAS v. 8.1. Pen of pigs was the experimental unit. Linear and quadratic polynomial contrasts were used to determine the effects of increasing TID lysine for the treatments fed ractopamine HCl. Polynomial contrasts were used to compare pigs fed ractopamine HCl with pigs fed the control diet. Percentage shrink was calculated on all pigs by subtracting the farm weight from the plant weight, divided by the farm weight.

Results and Discussion

Experiment 1. Overall (d 0 to 21), pigs fed diets with increasing TID lysine had improved ADG (linear, ($P<0.02$) and F/G (linear; $P<0.01$), but there was no further improvement feeding more than 1.05% TID lysine. Pigs fed ractopamine HCl had improved ($P<0.01$) ADG and F/G compared with performance of pigs fed the control diet. In this experiment, the optimum rate of TID lysine in the diet was shown to be 1.05% when 4.5 g/ton of ractopamine HCl is added to the diet, or 27.8 g of TID lysine per d, which is 26.6 g of TID lysine per kg of gain (12 g per lb of gain).

Pigs fed ractopamine HCl had improved ($P<0.03$) carcass weight, backfat, loin depth, FFLI, and income per pig, compared with those measures in pigs fed the control diet. Pigs fed increasing rates of TID lysine had improved (linear; $P<0.02$) FFLI. Pigs fed diets with increasing rates of TID lysine had a trend

(linear; P<0.10) for decreased amounts of backfat and increased income per pig.

Experiment 2. Overall (d 0 to 21), increased rates of TID lysine in the diet improved (linear; P<0.01) ADG and F/G. Also, pigs fed ractopamine HCl had improved (P<0.03) ADG and F/G, compared with performance of pigs fed the control diet. But there was no improvement (P = 0.53) among treatments in final BW. The results of this experiment indicate that gilts fed 4.5 g per ton of ractopamine HCl should be fed at least 0.95% TID lysine, or 23.9 g of TID lysine per day, which is 23.3 g of TID lysine per kg of gain.

For carcass characteristics, there was an increase (linear; P<0.05) in percentage BW shrinkage with increasing rates of TID lysine in the diet. With increasing rates of TID lysine in the diet, backfat decreased (linear; P<0.04). Pigs fed ractopamine HCl had improved FFLI (P<0.03), compared with that of pigs fed the control diet and tended (P<0.10) to have heavier carcass weight and increased income per pig.

In conclusion, dietary lysine must be increased in diet containing ractopamine HCl before slaughter for optimum growth performance and carcass characteristics, compared with a typical late finishing diet without ractopamine HCl. The results of these experiments indicate that gilts fed ractopamine HCl (5 to 6.75 ppm) should be fed a corn-soybean meal diet formulated to at least 0.95% TID lysine, which supplies the gilts with 26 g/d of TID lysine and at least 25 g of TID lysine/kg of gain for optimal live growth performance and carcass composition.

Table 1. Diet Composition for Exp. 1 (As-fed Basis)

	TID Lysine Level %					
Ingredient, %	0.65	0.75	0.85	0.95	1.05	1.15
Corn	82.58	83.45	79.47	75.48	71.50	67.51
Soybean meal (46.5% CP)	13.25	12.00	15.95	19.91	23.86	27.81
Choice white grease	2.00	2.00	2.00	2.00	2.00	2.00
Monocalcium phosphate (21% P)	0.60	0.60	0.60	0.60	0.60	0.60
Limestone	0.85	0.85	0.85	0.85	0.85	0.85
Salt	0.40	0.40	0.40	0.40	0.40	0.40
L-lysine HCl	0.15	0.325	0.325	0.325	0.325	0.325
DL-methionine	0.00	0.038	0.061	0.084	0.106	0.129
L-threonine	0.025	0.138	0.153	0.169	0.184	0.20
L-tryptophan	0.00	0.0175	0.013	0.009	0.0045	0.00
Vitamin premix	0.025	0.05	0.05	0.05	0.05	0.05
Trace mineral premix	0.07	0.05	0.05	0.05	0.05	0.05
Copper sulfate	0.05	0.05	0.05	0.05	0.05	0.05
Paylean[a]	0.00	0.025	0.025	0.025	0.025	0.025
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
Total lysine, %	0.73	0.86	0.97	1.08	1.19	1.30
TID ratio, %						
Methionine:lysine	32	32	33	34	34	35
Methionine & cystine:lysine	66	60	60	60	60	60
Threonine:lysine	67	70	70	70	70	70
Tryptophan:lysine	18	17	17	18	17	17
ME, Kcal/lb	1,509	1,512	1,507	1,503	1,498	1,494
CP, %	13.31	15.83	17.40	18.97	20.56	22.14
Ca, %	0.48	0.50	0.51	0.52	0.54	0.55
P, %	0.45	0.48	0.49	0.51	0.53	0.55
Available P, %	0.18	0.19	0.19	0.20	0.20	0.21

[a]Experimental diets fed for 21 d before slaughter.
[b]Paylean fed at a rate of 5 ppm of ractopamine HCl per complete ton of feed.

Table 2. Diet Composition for Exp. 2 (As-fed Basis)[a]

	TID Lysine Level %					
Ingredient, %	0.65	0.75	0.85	0.95	1.05	1.15
Corn	82.58	76.02	72.03	68.02	64.00	59.98
Soybean meal (46.5% CP)	13.25	19.85	23.83	27.81	31.79	35.77
Choice white grease	2.00	2.00	2.00	2.00	2.00	2.00
Monocalcium phosphate (21% P)	0.60	0.60	0.60	0.60	0.60	0.60
Limestone	0.85	0.85	0.85	0.85	0.85	0.85
Salt	0.40	0.40	0.40	0.40	0.40	0.40
L-lysine HCl	0.15	0.075	0.075	0.075	0.075	0.075
DL-methionine	0.00	0.00	0.00	0.01	0.03	0.05
L-threonine	0.025	0.028	0.044	0.059	0.075	0.091
Vitamin premix	0.025	0.05	0.05	0.05	0.05	0.05
Trace mineral premix	0.07	0.05	0.05	0.05	0.05	0.05
Copper sulfate	0.05	0.05	0.05	0.05	0.05	0.05
Paylean[b]	0.00	0.025	0.025	0.025	0.025	0.025
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
Total lysine, %	0.73	0.84	0.94	1.05	1.16	1.27
TID amino acids, %						
Methionine:lysine	32	32	30	30	31	32
Methionine & cystine:lysine	66	65	62	60	60	60
Threonine:lysine	67	70	70	70	70	70
Tryptophan:lysine	18	21	21	21	21	21
ME Kcal/lb	1,509	1,500	1,496	1,491	1,487	1,482
CP, %	13.31	13.07	14.64	16.20	17.77	19.34
Ca, %	0.48	0.47	0.49	0.50	0.51	0.52
P, %	0.45	0.44	0.46	0.48	0.49	0.51
Available P, %	0.18	0.18	0.18	0.19	0.19	0.20

[a]Experimental diets fed for 21 d before slaughter.
[b]Paylean fed at a rate of 5 ppm of ractopamine HCl per complete ton of feed.

Table 3. Lysine Requirement of Gilts Fed Ractopamine HCl in a Commercial Facility (Exp. 1)[a]

	TID Lysine, %							Probability, P <			
	Control	With Ractopamine HCl									
Item	0.65	0.75	0.85	0.95	1.05	1.15	SE	Treatment	Linear	Quad[b]	Ractopamine HCl vs. Control
Initial wt, lb	218.3	215.4	215.6	218.3	217.8	219.4	3.7	0.85	0.19	0.99	0.75
Day 0 to 21											
ADG, lb	1.85	2.03	2.07	2.09	2.31	2.20	0.11	0.01	0.02	0.75	0.01
ADFI, lb	5.75	5.64	5.77	5.73	5.84	5.71	0.20	0.96	0.67	0.48	0.96
F/G	3.13	2.78	2.78	2.70	2.56	2.56	0.14	0.01	0.01	0.78	0.01
TID lysine/d, g	16.96	19.21	22.3	24.72	27.78	29.78	0.858	0.01	0.01	0.51	0.01
TID lysine/kg of gain, g	20.1	21.25	23.78	26.13	26.62	29.73	0.91	0.01	0.01	0.76	0.01
Final wt, lb	259.0	259.7	261.0	263.0	268.5	268.1	4.78	0.17	0.02	0.99	0.18
Final wt after removals, lb[c]	259.7	260.8	265.7	263.0	269.6	266.5	4.74	0.32	0.15	0.59	0.14
Plant wt, lb	256.2	258.6	263.7	262.1	267.0	263.0	4.27	0.19	0.22	0.30	0.44
Shrink, %[d]	1.37	0.84	0.74	0.26	1.01	1.31	0.54	0.33	0.32	0.16	0.20
Carcass wt, lb	194.0	196.9	201.9	200.2	203.9	200.4	3.8	0.14	0.29	0.26	0.03
Yield, %	75.7	76.1	76.6	76.3	76.4	76.2	0.01	0.72	0.99	0.54	0.16
Backfat, in	0.69	0.66	0.66	0.66	0.64	0.62	0.02	0.15	0.10	0.42	0.03
Loin depth, in	2.28	2.39	2.45	2.48	2.41	2.49	0.07	0.04	0.33	0.77	0.01
FFLI	49.96	50.44	50.63	50.55	50.92	51.01	0.253	0.01	0.02	0.73	0.01
Income/pig, $	136.06	138.79	141.3	140.15	142.57	142.61	2.322	0.07	0.10	0.83	0.01

[a]A total of 983 gilts (PIC L337 × L42), initially 217.4 lb, were used in a 21-d experiment, with 7 pens per treatment and a total of 42 pens.
[b]Quadratic.
[c]Average final weight after pigs with defects (belly ruptures and/or abscesses) were removed before being transported to the slaughter facility. The range of pigs removed was 1 to 3 per treatment.
[d]Shrink was calculated as the difference between average weight after removals and plant weight, divided by average weight after removals.

Table 4. Lysine Requirement of Gilts fed Ractopamine HCl in a Commercial Facility (Exp. 2)[a]

	TID Lysine, %							Probability, P <			
	Control	With Ractopamine HCl									
Item	0.65	0.75	0.85	0.95	1.05	1.15	SE	Trt[b]	Linear	Quad[c]	Ractopamine HCl vs. Control
Initial wt, kg	226.2	226.4	226.4	226.4	226.2	226.0	1.569	1.00	0.98	0.93	0.90
D 0 to 21											
ADG, lb	1.94	2.12	2.20	2.31	2.25	2.34	0.043	0.01	0.01	0.07	0.03
ADFI, lb	5.75	5.68	5.68	5.64	5.53	5.53	0.067	0.62	0.17	0.75	0.26
F/G	2.94	2.70	2.56	2.44	2.44	2.38	0.014	0.01	0.01	0.05	0.01
TID lysine/d, g	16.77	19.34	21.75	23.86	26.32	29.99	0.581	0.01	0.01	0.74	0.01
TID lysine/kg of gain, g	17.43	19.33	20.81	23.34	25.05	34.67	1.202	0.01	0.01	0.83	0.01
Final wt, lb	267.9	271.2	273.1	274.9	274.0	274.9	1.895	0.53	0.09	0.48	0.43
Plant wt, lb	266.1	268.5	270.9	272.7	269.0	270.7	2.022	0.76	0.73	0.53	0.20
Shrink, %[d]	0.68	0.93	0.78	0.84	1.53	1.49	0.415	0.19	0.05	0.45	0.19
Carcass wt, lb	199.3	202.6	204.1	204.8	203.5	203.9	1.500	0.60	0.80	0.61	0.09
FFLI	50.5	50.66	50.67	50.95	51.1	50.82	0.191	0.05	0.09	0.17	0.03
Backfat, in	0.66	0.67	0.66	0.64	0.62	0.65	0.459	0.14	0.04	0.14	0.41
Yield, %	74.9	75.4	75.4	75.1	75.0	75.3	0.005	0.85	0.85	0.74	0.22
Loin depth, in	2.48	2.51	2.52	2.50	2.52	2.52	0.968	0.80	0.68	0.94	0.19
Lean/pig, $	3.88	3.78	3.85	4.04	4.22	3.99	0.198	0.29	0.08	0.26	0.53
Value live/cwt, $	52.04	52.12	51.93	52.18	52.5	52.01	0.504	0.89	0.75	0.68	0.78
Income/pig, $	138.49	139.95	140.7	142.21	141.72	140.79	1.953	0.48	0.54	0.31	0.10

[a]A total of 932 gilts (PIC L337 × C22), initially 226.2 lb, were used in a 21-d experiment, with 7 pens (replications) per treatment and a total of 42 pens.

[b]Treatment.

[c]Quadratic.

[d]Shrink was calculated as the difference between average final weight, and plant weight, divided by average final weight.