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M J. Webster

Robert D. Goodband

D E. Real

See next page for additional authors

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Abstract

A total of 432 pigs were used to evaluate the effects of Paylean and dietary lysine on finishing pig growth performance, carcass characteristics and tissue accretion. The 12 dietary treatments included Paylean (0, 4.5, and 9.0 g/ton) and 4 levels of lysine. For pigs fed no Paylean, lysine levels were 0.60, 0.80, 1.00, and 1.20%. For pigs fed 4.5 or 9.0 g/ton of Paylean, lysine levels were 0.80, 1.00, 1.20, and 1.40%. The results indicate that pigs fed Paylean need at least 1.0% dietary lysine to optimize growth, carcass parameters, and tissue accretion.; Swine Day, Manhattan, KS, November 15, 2001

Keywords

Swine day, 2001; Kansas Agricultural Experiment Station contribution; no. 02-132-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 880; Swine; Paylean; Lysine; Finishing pigs; Accretion

Authors

M J. Webster, Robert D. Goodband, D E. Real, J C. Woodworth, T A. Marsteller, Michael D. Tokach, John A. Unruh, Jim L. Nelssen, Joel M. DeRouchey, and Steven S. Dritz

INTERACTIVE EFFECTS BETWEEN PAYLEAN™ (RACTOPAMINE HCL) AND DIETARY LYSINE ON FINISHING PIG GROWTH PERFORMANCE, CARCASS CHARACTERISTICS AND TISSUE ACCRETION [1]

M. J. Webster, R. D. Goodband, M. D. Tokach, J. A. Unruh, J. L. Nelssen, S. S. Dritz [2], D. E. Real, J. M. DeRouchey, J. C. Woodworth, and T. A. Marsteller [3]

Summary

A total of 432 pigs were used to evaluate the effects of Paylean and dietary lysine on finishing pig growth performance, carcass characteristics and tissue accretion. The 12 dietary treatments included Paylean (0, 4.5, and 9.0 g/ton) and 4 levels of lysine. For pigs fed no Paylean, lysine levels were 0.60, 0.80, 1.00, and 1.20%. For pigs fed 4.5 or 9.0 g/ton of Paylean, lysine levels were 0.80, 1.00, 1.20, and 1.40%. The results indicate that pigs fed Paylean need at least 1.0% dietary lysine to optimize growth, carcass parameters, and tissue accretion.

(Key Words: Paylean, Lysine, Finishing Pigs, Accretion.)

Introduction

In 1999, the FDA approved Paylean to be used in finishing pig diets. Extensive research has shown that Paylean improves growth performance and carcass leanness by directing nutrients away from fat deposition and toward protein deposition. To support the increased protein deposition, it is very likely that dietary lysine concentrations will need to be increased. Therefore, the objective of this experiment was to evaluate the interactive effects of dietary lysine and Paylean dosage on finishing pig growth performance, carcass characteristics, and tissue accretion.

Procedures

Four hundred thirty-two pigs (PIC 326 × C22) averaging 175 lb were used in this experiment. The experiment was divided into two identical trials, the first beginning in October 2000, and the second starting in February 2001. Procedures were identical for both trials. Pigs were housed with three per pen and 12 pens (5 × 5 ft) per treatment (six pens of barrows and six pens of gilts) in a randomized complete block design. Pigs were blocked by initial weight and sex, and then randomly allotted to one of the 12 experimental treatments. Feed and water were provided ad libitum.

The experiment was arranged in an incomplete 3 × 4 factorial. Main effects included Paylean dosage (0, 4.5 and 9 g/ton) and dietary lysine. Control diets contained 0.60, 0.80,1.00, and 1.20% total lysine and for pigs fed Paylean, diets contained 0.80, 1.00, 1.20, and 1.40% total lysine (Table 1). Dietary treatments were fed for four weeks from approximately 175 to 240 lb. The primary difference in the diet formulation among treatments was an adjustment in the corn:soybean meal ratio. Amino acid ratios were maintained in all diets to ensure lysine was first limiting (NRC, 1998). Complete diets were sampled and analyzed for dry matter, crude protein, and Paylean.

Pigs were weighed and feed disappearance determined every 7 days during the 28

[1]The authors wish to thank Elanco Animal Health, a division of Eli Lilly Corporation, Indianapolis, IN, for partial funding of the experiment.

[2]Food Animal Health and Management Center.

[3]Elanco Animal Health, Indianapolis, IN.

d experiment. At the beginning of the trial, pigs were randomly assigned either to mid-point slaughter (d 14), ending slaughter (d 28) or as an alternate in case a pig was removed due to death, sickness, or being 2 standard deviations from treatment mean.

One pig per pen was processed at the KSU Meat Lab on d 14 (midpoint) and 28 (end) of the trial. At 24 hours postmortem, carcass parameters were measured on the right side of the carcass. Average backfat (first rib, last rib, and last lumbar), tenth rib fat depth, longissimus muscle area, and carcass weight were determined.

Daily accretion rates of moisture, crude protein, fat, and ash were also determined. At the start of each trial, six randomly selected pigs (equal number of each sex) were slaughtered. At 24 hours postmortem, the left side from each carcass was allowed to freeze in a blast freezer for approximately 1.5 h. After freezing, sides were ground once through a meat grinder equipped with a 3/4 inch die then ground twice through a second meat grinder equipped with a 3/8 inch die. A subsample of ground carcass was then chemically analyzed to determine percentages of crude protein, moisture/dry matter, lipid and ash. This procedure was then repeated on the left side of each carcass of all pigs slaughtered on d 14 and 28 of the study.

Carcass accretion rates were calculated by multiplying the percentages of moisture, protein, lipid and ash determined in the initial 12 pigs slaughtered at the start of the study by their chilled carcass weight. Percentages of moisture, protein, lipid and ash were then determined in the pigs slaughtered on d 14 and 28 and multiplied by their respective cold carcass weights. The values at the start of the study were subtracted from those on d 14 and 28 and divided by 14 and 28 to calculate a daily carcass accretion rate.

Data were analyzed in a randomized complete block design using the general linear model (GLM) procedures of SAS with pen as the experimental unit. Linear and quadratic polynominal contrasts were performed to determine the effects of increasing levels of dietary lysine within each Paylean level and increasing levels of Paylean.

Results

Growth Performance. From d 0 to 14, a trial × treatment interaction ($P<0.01$) was observed for ADG and F/G (Table 2). The interaction occurred because we observed an improvement in ADG and F/G with increasing lysine among control pigs in Trial 1 but not in Trial 2. Also, in Trial 2, ADG, and F/G was poorer for pigs fed 9.0 g/ton Paylean and 1.4% lysine than those fed 1.2% lysine, but in Trial 1, pigs fed 1.4% lysine and 9.0 g/ton Paylean had similar growth performance to those fed 1.2% lysine. Despite these interactions, there was an improvement (quadratic, $P<0.04$) in ADG and F/G as Paylean increased. For pigs fed 4.5 and 9.0 g/ton of Paylean, there was a decrease (linear, $P<0.02$) in ADFI as lysine increased. Increasing lysine improved (quadratic, $P<0.007$) F/G at each Paylean level.

For the overall growth trial, as Paylean increased, there was an increase (quadratic, $P<0.003$) in ADG. Furthermore, increasing dietary lysine tended to increase ADG (linear, $P<0.09$) and improved (linear, $P<0.01$) F/G in control pigs. For pigs fed Paylean, increasing dietary lysine increased and improved (quadratic, $P<0.07$ and $P<0.04$, respectively) ADG and F/G. Also, for pigs fed Paylean, increasing dietary lysine decreased (linear, $P<0.05$) ADFI.

Carcass Characteristics. For carcass data collected from pigs slaughtered on d 14 of the study (Table 3), several trial*sex interactions were observed. However, these interactions were due to a difference in the magnitude of response between the barrows and gilts when comparing the two trials. In general, we observed greater differences between gilts and barrows in Trial 2 than we did in Trial 1. These parameters included cold carcass weight, tenth rib backfat, last rib backfat, and average backfat thickness. In addition, there was a significant trial × treatment interaction for average backfat. For pigs fed 9.0 g/ton of Paylean, increasing lysine decreased backfat thickness in Trial 1;

however, there was a slight increase in backfat thickness with increasing lysine in Trial 2.

As Paylean dosage increased, there was an increase (linear, P<0.01) in cold and hot carcass weight and decreased (linear, P<0.02) leaf fat. Pigs fed the control diet had a decrease (linear, P<0.05) in first rib backfat as dietary lysine increased.

For the carcass data collected from pigs slaughtered on d 28 (Table 4), there were several trial × sex interactions. Similar to the midpoint carcass data, these interactions were magnitude differences observed between barrows and gilts in the two trials. The parameters affected included cold carcass weight, leaf fat, and, tenth rib backfat.

Pigs fed increasing Paylean had a increase (linear, P<0.0003) in live weight, percentage yield, hot, and cold carcass weights. Furthermore, as Paylean levels increased, leaf fat, tenth rib backfat, and average backfat thickness decreased (linear, P<0.01). As Paylean increased, lean percentage and loin eye area increased (linear, P<0.01). At 4.5 g/ton of Paylean, pigs had decreased (quadratic, P<0.04) live, hot, and cold carcass weight as dietary lysine increased. In pigs fed 4.5 g/ton of Paylean, leaf fat and tenth rib backfat decreased (linear, P<0.01) and lean percentage and loin eye area increased (quadratic, P<0.05) with increasing dietary lysine. For pigs fed Paylean, there was a decrease (linear, P<0.03) in average backfat thickness as lysine increased. For pigs fed 4.5 g/ton of Paylean, there was a increase (quadratic, P<0.05) in lean percentage and loin eye area as the lysine levels increased.

Tissue Accretion. A trial × treatment interaction was observed from d 0 to 14 tissue accretion data (Table 5) because moisture accretion was lower for pigs fed 0.6% lysine and no Paylean in Trial 1 than in Trial 2.

On d 14, as Paylean increased, the percentage moisture and protein increased (linear, P<0.03) and fat percentage decreased (linear, P<0.03). This agrees with the tissue accretion in the first two weeks. From d 0 to 14, as Paylean increased, there was an increase (linear, P<0.0001) in protein and moisture accretion. In pigs fed no Paylean, moisture accretion increased (quadratic, P<0.01) as dietary lysine increased. Also, in pigs fed 9.0 g/ton of Paylean, the moisture accretion increased (linear, P<0.04) as lysine increased. There were no differences in fat accretion from d 0 to 14 for any of the treatments. However, for control pigs (no Paylean), protein accretion increased (linear, P<0.005 and quadratic, P<0.04) as lysine levels increased.

From d 0 to 28, as Paylean increased, there was an increase (linear, P<0.0001 and quadratic, P<0.02, respectively) in protein and moisture accretion. Also, as Paylean increased, there was a decrease (linear, P<0.01) in fat accretion. Additionally, by adding Paylean or lysine to the diet, there was an increase (linear, P<0.02 and P<0.01, respectively) in moisture and protein percentages and a decrease (linear, P<0.03) in fat percentage.

In pigs fed 4.5 g/ton of Paylean, moisture accretion increased (linear, P<0.03) and protein accretion increased (quadratic, P<0.03) as lysine increased. Also, in Paylean fed pigs, fat accretion decreased (linear, P<0.03) as lysine increased.

Discussion

The results from this experiment suggest that in the first two weeks and the overall 28 d period, pigs fed Paylean (175 to 215 lb) gained weight considerably faster than control pigs. For control pigs, feeding at least 0.80% dietary lysine improved growth performance. It would appear that 1.0% lysine was sufficient for pigs fed 4.5 g/ton Paylean. However, from day 0 to 14 in pigs fed 9.0 g/ton Paylean, improvements in growth performance were observed through 1.2% lysine. This growth response agrees with the previous research that shows more lysine is required when pigs are fed Paylean, especially during the first two weeks that the Paylean is fed.

During the first two weeks in pigs fed Paylean, leaf fat, last lumbar backfat, and average backfat decreased and loin eye area increased. The carcass characteristics at the end of the four-week trial had a more dramatic response to Paylean when compared to the response in carcass characteristics after the first two weeks.

For pigs fed Paylean, there was an increase in moisture and protein accretion in the first two weeks. For the overall trial, Paylean increased moisture and protein accretion and decreased fat accretion. This indicates that the response to Paylean during the first two weeks of feeding is an increase in muscle accretion. The predominant response during the last two weeks is a decrease in fat accretion. In the first two weeks, the only response to lysine levels was an increase in moisture and protein accretion in control pigs. However, the response in the last two weeks is that as the lysine increased, fat accretion decreased and protein accretion increased. This response indicates that pigs fed the highest lysine levels in all Paylean levels were the leanest.

In conclusion, Paylean increases growth performance by increasing lean gain and decreasing fat accretion. This results in a faster gaining, leaner pig. With the wide range of lysine levels used in our study, our data would suggest pigs fed Paylean require at least 1.0% dietary lysine.

Table 1. Diet Composition

	Dietary Lysine, %[a]				
Ingredient,%	0.60	0.80	1.00	1.20	1.40
Corn[b]	84.60	77.34	70.10	62.84	54.54
Soybean meal (47% CP)	12.60	19.86	27.12	34.37	42.63
Monocalcium phosphate (21% P)	1.15	1.15	1.10	1.05	1.00
Limestone	0.90	0.90	0.90	0.90	0.90
Salt	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
L-isoleucine	—	—	0.01	0.03	0.06
L-threonine	—	—	0.00	0.00	0.02
DL-methionine	—	—	0.02	0.06	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein, %	13.2	16.0	18.8	21.7	24.5
Total lysine, %	0.60	0.80	1.00	1.20	1.40
True digestible lysine, %	0.51	0.70	0.88	1.06	1.24
ME, kcal/lb	1,506	1,504	1,503	1,502	1,500
Lysine:cal ratio, g/mcal	1.81	2.41	3.02	3.62	4.23
Calcium, %	0.62	0.65	0.66	0.67	0.69
Phosphorus, %	0.57	0.60	0.61	0.63	0.65
Available phosphorus, %	0.29	0.30	0.30	0.30	0.30

[a]Diets containing 0.60, 0.80, 1.00, and 1.20% lysine were fed to control pigs (no Paylean). Pigs fed 4.5 and 9.0 g/ton of Paylean had lysine levels of 0.80, 1.00, 1.20, and 1.40%.
[b]Paylean replaced corn to provide 4.5 or 9.0 g/ton.

Table 2. Effects of Increasing Dietary Lysine and Paylean on Growth Performance of Finishing Pigs[a]

Paylean, g/ton:	0.0				4.5				9.0				
Lysine, %:	0.6	0.8	1.0	1.2	0.8	1.0	1.2	1.4	0.8	1.0	1.2	1.4	SEM
Day 0 to 14													
ADG, lb	2.08	2.25	2.35	2.24	2.42	2.72	2.66	2.53	2.51	2.70	2.85	2.69	0.07
ADFI, lb	6.68	6.75	6.53	6.50	6.97	6.85	6.55	6.38	7.02	6.81	6.78	6.52	0.14
F/G	3.26	3.01	2.80	2.92	2.91	2.53	2.47	2.53	2.82	2.54	2.38	2.45	0.07
Day 0 to 28													
ADG, lb	2.14	2.19	2.29	2.26	2.41	2.58	2.50	2.42	2.49	2.57	2.57	2.46	0.06
ADFI, lb	7.02	7.13	6.85	6.91	7.12	7.11	6.84	6.69	7.01	7.04	6.98	6.58	0.15
F/G	3.29	3.26	3.01	3.09	3.00	2.76	2.75	2.78	2.83	2.74	2.74	2.70	0.07

	Lysine Linear Contrast, P<			Lysine Quadratic Contrast, P<			Paylean	
	0	4.5	9	0	4.5	9	Linear	Quadratic
Day 0 to 14								
ADG**	0.05	0.33	0.019	0.04	0.001	0.007	0.0001	0.003
ADFI	0.24	0.001	0.016	0.73	0.85	0.85	0.09	0.89
F/G**	0.0001	0.0001	0.0001	0.006	0.001	0.007	0.0001	0.0001
Day 0 to 28								
ADG	0.09	0.83	0.72	0.47	0.03	0.07	0.001	0.003
ADFI	0.39	0.02	0.05	0.85	0.66	0.15	0.51	0.99
F/G	0.006	0.03	0.20	0.43	0.04	0.72	0.0001	0.001

[a]A total of 432 pigs with an average initial weight of 175 lb was used in this experiment. Values represent the mean of 12 pens/treatment with 3 (d 0 to 14) and 2 (d 14 to 28) pigs per pen.
*Sex by trial interaction (P<0.05).
**Trial by treatment interaction (P<0.05).
***Sex by treatment interaction (P<0.05).

Table 3. Effect of Dietary Lysine and Paylean on Carcass Characteristics, Day 14[a]

Paylean, g/ton:	0.0				4.5				9.0				
Lysine, %:	0.6	0.8	1.0	1.2	0.8	1.0	1.2	1.4	0.8	1.0	1.2	1.4	SEM
Live wt, lb	205.0	202.7	207.2	208.4	204.6	205.3	212.8	207.2	212.8	206.9	214.1	209.0	3.63
Yield, %	72.6	72.9	73.0	72.8	73.5	73.1	73.6	73.8	73.4	73.9	72.9	73.2	0.41
Hot carcass wt, lb	148.3	147.2	150.9	151.5	150.2	149.5	156.7	152.9	156.5	152.9	156.4	153.2	2.76
Cold carcass wt, lb	147.0	146.4	149.6	150.4	149.2	148.5	155.7	151.6	155.0	151.6	156.3	151.6	2.81
Carcass length, in	31.4	31.1	31.4	31.4	31.5	31.6	31.2	31.1	31.1	31.4	31.2	30.9	0.21
Leaf fat, lb	2.12	1.89	1.76	1.81	1.71	2.16	1.62	1.47	1.78	1.61	1.25	1.58	0.19
Backfat thickness, in													
First rib	1.54	1.56	1.27	1.43	1.43	1.56	1.36	1.45	1.41	1.44	1.31	1.33	0.07
Last rib	0.82	0.78	0.78	0.78	0.79	0.76	0.84	0.80	0.78	0.80	0.73	0.71	0.03
Last lumbar	0.60	0.56	0.51	0.52	0.52	0.55	0.52	0.50	0.55	0.52	0.45	0.46	0.03
Average backfat	0.98	0.97	0.85	0.91	0.91	0.96	0.91	0.92	0.91	0.92	0.83	0.83	0.03
Tenth rib	0.62	0.70	0.61	0.65	0.67	0.62	0.57	0.55	0.62	0.62	0.64	0.59	0.06
Percentage lean	55.1	54.2	55.8	54.8	54.5	54.4	56.2	56.3	55.7	55.8	56.4	56.5	0.89
Loin eye area, in^2	5.61	5.69	5.82	5.65	5.59	5.70	5.91	5.75	5.86	5.94	6.28	5.97	0.19

	Lysine Linear Contrast, P<			Lysine Quadratic Contrast, P<			Paylean	
	0	4.5	9	0	4.5	9	Linear	Quadratic
Live wt*	0.37	0.36	0.79	0.63	0.41	0.91	0.06	0.70
Yield	0.63	0.46	0.42	0.50	0.47	0.85	0.08	0.09
Hot carcass wt*	0.29	0.23	0.60	0.78	0.54	0.95	0.01	0.85
Cold carcass wt*	0.28	0.25	0.67	0.82	0.54	0.81	0.01	0.87
Carcass length	0.76	0.15	0.34	0.42	0.54	0.17	0.32	0.39
Leaf fat	0.22	0.14	0.25	0.46	0.11	0.19	0.02	0.91
Backfat Thickness								
First rib	0.05	0.66	0.20	0.29	0.82	0.96	0.12	0.30
Last rib*	0.49	0.43	0.07	0.57	0.76	0.56	0.16	0.25
Last lumbar	0.04	0.45	0.01	0.43	0.38	0.51	0.02	0.82
Average backfat**	0.03	0.79	0.03	0.26	0.60	0.98	0.03	0.26
Tenth rib*	0.92	0.10	0.76	0.68	0.80	0.62	0.44	0.44
Percentage lean	0.89	0.13	0.44	0.94	0.63	0.98	0.10	0.92
Loin eye area	0.75	0.44	0.44	0.52	0.50	0.33	0.03	0.33

[a]A total of 432 pigs with an average initial weight of 175 lb was used in this experiment. Values represent the mean of 12 pens/treatment with 3 (d 0 to 14) and 2 (d 14 to 28) pigs per pen. *Sex by trial interaction (P<0.05). **Trial by treatment interaction (P<0.05). ***Sex by treatment interaction (P<0.05).

Table 4. Effect of Dietary Lysine and Paylean on Carcass Characteristics, Day 28[a]

Paylean, g/ton:	0.0				4.5				9.0				
Lysine, %:	0.6	0.8	1.0	1.2	0.8	1.0	1.2	1.4	0.8	1.0	1.2	1.4	SEM
Live wt, lb	230.3	232.9	225.8	233.7	236.8	246.3	239.9	234.6	240.3	240.2	242.7	238.1	3.58
Yield, %	73.7	73.7	73.9	73.3	74.1	74.6	74.2	74.1	74.8	75.8	74.6	74.6	0.38
Hot carcass wt, lb	169.0	171.1	166.0	170.7	175.4	184.7	178.3	173.7	180.1	182.5	181.7	177.8	2.81
Cold carcass wt, lb	166.7	168.8	163.7	168.4	173.3	182.5	176.0	171.5	178.3	179.9	179.2	175.5	2.78
Carcass length, in	32.3	32.3	32.2	32.5	32.2	32.1	32.1	33.2	32.0	32.4	32.5	31.6	0.43
Leaf fat, lb	2.65	2.64	2.48	2.60	2.51	2.09	1.95	1.90	2.17	1.94	1.72	1.86	0.15
Backfat thickness, in													
First rib	1.46	1.46	1.48	1.44	1.47	1.43	1.36	1.36	1.43	1.40	1.32	1.28	0.05
Last rib	0.91	0.89	0.89	0.88	0.92	0.86	0.88	0.82	0.91	0.86	0.86	0.86	0.03
Last lumbar	0.63	0.65	0.64	0.61	0.58	0.59	0.53	0.49	0.54	0.52	0.50	0.49	0.03
Average backfat	1.00	1.00	1.00	0.98	0.99	0.96	0.92	0.89	0.96	0.93	0.89	0.88	0.03
Tenth rib	0.80	0.74	0.76	0.77	0.77	0.74	0.71	0.59	0.66	0.68	0.63	0.65	0.04
Percentage lean	51.9	53.2	52.9	53.5	53.5	54.7	54.7	54.9	55.1	55.0	55.2	55.2	0.73
Loin eye area, in^2	5.83	5.99	5.93	6.24	6.31	6.69	6.54	6.09	6.48	6.51	6.35	6.49	0.21

	Lysine Linear Contrast, P<			Lysine Quadratic Contrast, P<			Paylean	
	0	4.5	9	0	4.5	9	Linear	Quadratic
Live wt*	0.85	0.42	0.80	0.47	0.04	0.53	0.0003	0.08
Yield	0.59	0.92	0.29	0.37	0.46	0.19	0.0001	0.83
Hot carcass wt*	0.99	0.37	0.55	0.65	0.02	0.27	0.0001	0.07
Cold carcass wt*	0.99	0.33	0.47	0.63	0.01	0.34	0.0001	0.06
Carcass length	0.88	0.11	0.59	0.72	0.19	0.16	0.56	0.50
Leaf fat	0.65	0.01	0.10	0.67	0.24	0.23	0.0001	0.14
Backfat Thickness								
First rib	0.90	0.09	0.02	0.70	0.69	0.89	0.01	0.84
Last rib*	0.51	0.04	0.21	0.87	0.91	0.37	0.42	0.46
Last lumbar	0.60	0.02	0.17	0.38	0.41	0.90	0.0001	0.20
Average backfat**	0.63	0.01	0.03	0.64	0.98	0.79	0.002	0.42
Tenth rib*	0.61	0.003	0.64	0.39	0.29	0.97	0.001	0.74
Percentage lean	0.18	0.20	0.87	0.62	0.54	0.94	0.0002	0.29
Loin eye area	0.20	0.37	0.87	0.72	0.05	0.79	0.01	0.15

[a]A total of 432 pigs with an average initial weight of 175 lb was used in this experiment. Values represent the mean of 12 pens/treatment with 3 (d 0 to 14) and 2 (d 14 to 28) pigs per pen. *Sex by trial interaction (P<0.05). **Trial by treatment interaction (P<0.05). ***Sex by treatment interaction (P<0.05).

Table 5. Effect of Dietary Lysine and Paylean on Chemical Composition and Tissue Accretion[a]

Paylean, g/ton:	0.0				4.5				9.0				
Lysine, %:	0.6	0.8	1.0	1.2	0.8	1.0	1.2	1.4	0.8	1.0	1.2	1.4	SEM
Day 14, Chemical Composition, %													
Moisture	58.2	59.2	60.2	59.5	60.1	59.5	60.1	60.4	59.5	59.7	61.0	61.4	0.62
Fat	20.6	19.5	18.1	18.0	18.0	18.9	17.8	18.1	18.9	18.6	17.0	17.0	0.84
Protein	17.3	17.7	17.7	17.9	17.8	17.7	18.2	17.9	17.9	17.8	18.2	18.0	0.22
Ash	3.22	3.33	3.13	3.26	3.32	3.21	3.24	3.21	2.88	3.23	3.18	3.17	0.14
Day 28, Chemical Composition, %													
Moisture	56.9	57.3	57.5	57.7	57.8	58.3	59.8	60.7	59.0	58.8	60.1	60.6	0.59
Fat	22.0	21.3	21.2	20.3	21.3	20.3	18.4	17.4	19.2	19.8	17.7	17.4	0.80
Protein	17.1	17.2	17.6	17.6	17.4	17.7	18.2	18.2	18.1	18.0	18.4	18.3	0.26
Ash	3.28	3.33	3.14	3.14	3.00	3.12	3.00	3.10	3.03	3.11	3.11	3.10	0.14
Day 0 to 14, Tissue Accretion, g/d													
Moisture	269	404	497	400	457	429	555	500	501	526	604	608	51
Fat	249	225	176	182	168	213	179	171	227	215	143	151	52
Protein	122	170	181	173	181	174	224	191	205	205	227	215	16
Ash	38	46	39	43	46	42	47	42	33	46	44	44	9
Day 0 to 28, Tissue Accretion, g/d													
Moisture	379	389	401	398	461	543	541	539	535	546	563	562	25
Fat	216	195	191	171	212	213	141	111	168	194	125	114	26
Protein	133	136	145	151	159	187	189	182	191	191	199	188	10
Ash	33	34	30	30	28	35	29	31	31	34	33	32	4

Table 5. Continued

	Lysine linear contrast, P<			Lysine quadratic contrast, P<			Paylean	
	0	4.5	9	0	4.5	9	Linear	Quadratic
Day 14, Chemical Composition, %								
Moisture**	0.09	0.53	0.02	0.18	0.49	0.83	0.02	0.66
Fat*	0.06	0.81	0.06	0.31	0.70	0.90	0.03	0.54
Protein*	0.07	0.46	0.57	0.56	0.82	0.76	0.03	0.42
Ash	0.92	0.60	0.21	0.96	0.76	0.20	0.21	0.41
Day 28, Chemical Composition, %								
Moisture*	0.33	0.0002	0.02	0.82	0.73	0.58	0.0001	0.07
Fat	0.16	0.0003	0.03	0.92	0.96	0.58	0.0001	0.31
Protein	0.08	0.01	0.39	0.79	0.57	0.97	0.0001	0.46
Ash	0.32	0.77	0.73	0.86	0.93	0.75	0.16	0.22
Day 0 to 14, Tissue Accretion, g/d								
Moisture**	0.01	0.17	0.04	0.01	0.74	0.81	0.0001	0.72
Fat*	0.19	0.89	0.14	0.73	0.52	0.82	0.45	0.61
Protein*	0.006	0.16	0.41	0.04	0.32	0.62	0.0001	0.52
Ash	0.73	0.83	0.46	0.70	0.99	0.44	0.77	0.56
Day 0 to 28, Tissue Accretion, g/d								
Moisture*	0.51	0.02	0.32	0.79	0.07	0.79	0.0001	0.001
Fat	0.19	0.001	0.03	0.99	0.49	0.44	0.01	0.86
Protein	0.09	0.07	0.97	0.88	0.03	0.51	0.0001	0.02
Ash	0.39	0.86	0.92	0.77	0.47	0.58	0.69	0.51

[a]A total of 432 pigs with an average initial weight of 175 lb was used in this experiment. Values represent the mean of 12 pens/treatment with 3 (d 0 to 14) and 2 (d 14 to 28) pigs per pen.
*Sex by trial interaction (P<0.05).
**Trial by treatment interaction (P<0.05).
***Sex by treatment interaction (P<0.05).