DIETARY LYSINE AND SLAUGHTER WEIGHT AFFECT GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS IN BOARS AND BARROWS

M. M. Rantanen, R. H. Hines, J. D. Hancock, I. H. Kim, and K. G. Friesen

Summary

During the growing and finishing period, the boars ate less, had better F/G, and were less fat than barrows. A high plane of nutrition (high vs moderate lysine concentrations for the growing-finishing phases) and decreasing slaughter weight from 260 to 220 lb also improved efficiency of gain and carcass leanness. However, many notable interactions occurred among the gender × lysine × slaughter weight treatments. Also, year (rotational-cross of average health status and lean growth potential vs a terminal-cross of high lean growth potential after repopulation of the farm) had pronounced effects on growth performance and carcass merits such that the combination of lean genotype-boars-high lysine-220 lb had advantages of 15, 20, 39, 49, and 15% for ADG, ADFI, and F/G, avg backfat thickness, and fat-free lean index, respectively, compared to the control (i.e., the avg lean growth-barrows-moderate lysine-260 lb treatment).

(Key Words: Barrows, Boars, Genotype, Slaughter Weight.)

Introduction

In countries such as Denmark, Britain, Spain, and Australia, boars are routinely fed for meat production. The reported advantages to feeding boars include greater carcass leanness, greater ADG, greater efficiency of gain, and reduced concern about animal discomfort (caused by the castration process) with modern swine production practices. However, the potential for boar odor, especially with current trends for slaughter weights in excess of 250 lb, is a serious concern in the U.S. fresh-meat market. Therefore, we designed an experiment to determine the merits of a high plane of nutrition (to accelerate the growth curve) and decreased slaughter weight to allow capture of the greater growth performance of boars and yet avoid the potential for boar odor in fresh meat products.

Procedures

Two groups (group one in 1994 and group two in 1995) of pigs (avg initial wt of 11.7 lb and avg age of 18 d) were allotted by weight and ancestry (five pigs per pen and 20 pens per treatment) and used in a 38-d growth assay to determine the effects of gender (barrows vs boars) on growth performance of nursery pigs. The first group of pigs (Yorkshire × Hampshire × Chester White × Duroc rotational-cross) had medium-lean growth potential and average health status. The second group of pigs (PIC line 326 boars × C15 sows terminal-cross) had high-lean growth potential and health status (i.e., the first group of pigs through the facilities after the depopulation-repopulation). All pigs were fed the same diets (Table 1) for d 0 to 10 (1.6% lysine), 10 to 24 (1.4% lysine), and 24 to 38 (1.35% lysine) post-weaning. The pigs were housed in 4 ft × 5 ft pens with woven wire flooring. Room temperatures were 90, 87, 84, 80, and 75°F for wk 1, 2, 3, 4, and 5, respectively. Each pen had a self-feeder and nipple waterer to allow ad libitum consumption of feed and water. The pigs and feeders were weighed on d 0, 10, 24, and 38 to allow calculation of ADG, ADFI, and F/G.

For the growing-finishing phase, the pigs were reallotted (two pigs per pen) and housed in an environmentally controlled finishing

barn with totally slatted floors. Eighty of the year 1 pigs (medium-lean growth with an initial wt of 69 lb) and 80 of the year 2 pigs (high-lean growth with an initial wt of 74 lb) were used. The experiment was conducted in a 2 × 2 × 2 factorial with main effects of gender (barrows vs boars), lysine concentration regimen (moderate, .9 and .7% vs high, 1.3 and 1.1% for the growing-finishing phases, respectively), and slaughter weight (220 vs 260 lb). The grower (Table 1) diets were fed to a pen mean weight of 150 lb. At 150 lb, the pigs were switched to finishing diets that were fed until slaughter. The lysine concentrations for the moderate vs high treatments were selected by review of recommendations from the Agriculture Research Council in England, the National Research Council in the U.S., the Commonwealth Scientific and Industrial Research Organization of Australia, the Rowett Institute of Scotland, the University of Kentucky, and the University of Illinois. All vitamin and mineral concentrations were in excess of NRC (1988) recommendations. Slaughter weight treatments were 220 lb (typical for countries that produce boars for meat) and 260 lb (typical for packing plants in the U.S.).

The pigs and feeders were weighed every 7 d to allow calculation of ADG, ADFI, and F/G. Hot carcass weight was recorded at slaughter, and all other carcass measurements were collected 24 h later. Dressing percentage was calculated with hot carcass weight as a percentage of live weight. Backfat thickness was measured at the first rib, last rib, and last lumbar vertebra from both sides of the carcass and used to calculate average backfat thickness. Tenth-rib fat depth was measured at 3/4 the distance across the longissimus muscle. The longissimus muscle was traced and the area measured using a planimeter. Fat free lean index (FFLI) was calculated from hot carcass weight and last rib fat depth, using the NPPC equation.

All data were analyzed using the GLM procedure of SAS, with year (genotype) as the unreplicated whole plot and a 2 × 2 × 2 (gender × lysine regimen × slaughter weight) factorial arrangement of treatments in the subplot. Before statistical treatment, carcass measurements were adjusted to the targeted endpoint weights of 220 and 260 lb by using slaughter weight as a covariable. The two-, three-, and four-way interactions among the whole plot and subplot effects were tested, but only those with probability values of .10 or less are included in the tables of this report.

Results and Discussion

Differences for year (genotype) were apparent for most of the response criteria during the nursery experiments (Table 2). However, the effects of year cannot be credited completely to the change in genotype because of depopulation/repopulation (i.e., improved health status) when the farm was stocked with the high-lean growth genotype. Indeed, one might expect differences because of lean growth potential to be expressed as improved efficiency of gain during the growing-finishing phases and greater carcass leanness at market weight. Barrows and boars did not differ in growth performance up to d 24 of the experiment. However, from d 24 to 38, the boars ate less feed ($P < .05$) and were more efficient than barrows ($P < .02$). Although differences in F/G are anticipated for barrows vs boars during the growing-finishing phase, the differences during wk 4 and 5 of our nursery experiment were unexpected. Nonetheless, advantages in growth performance for boars apparently begin at or near 42 d of age.

During the growing period and overall (Tables 3 and 4), year had significant effects on ADG ($P < .001$) and F/G ($P < .06$), with greater growth performance during year 2 (after the repopulation). As noted for the nursery data, the year effect is probably a combination of influence from the change in genotype and improved health status immediately after a depopulation/repopulation. Nonetheless, the year 2 (terminal-cross) pigs reached slaughter weight 12 days sooner that the rotational-cross pigs ($P < .001$).

Barrows and boars had similar ADG to 150 lb; however, boars consumed less feed and had better F/G ($P < .01$). These same

effects were noted during the finishing phase for the overall experiment.

Lysine concentration (high vs moderate) had no effect on ADG, ADFI, or F/G during the growing period ($P > .26$). However, from 150 lb to slaughter weight and overall, pigs consuming the high lysine regimen ate less feed and had better F/G compared to pigs fed moderate lysine concentrations ($P < .06$).

As for the slaughter weight treatments, pigs slaughtered at 220 lb had greater ADG and better F/G than those slaughtered at 260 lb ($P < .01$). Boars had lower dressing percentages and greater FFLI's than barrows, and pigs slaughtered at 260 lb had larger LEA and greater dressing percentages than pigs slaughtered at 220 lb ($P < .001$). However, as for the growth data, notable interactions occurred among the treatments for carcass data. Pigs from year 1 (medium-lean growth) accumulated more 10th rib backfat thickness with the greater slaughter weight than did the year 2 (high-lean growth) pigs (year × slaughter wt interaction, $P < .01$). The LEA of boars was greater than that of barrows in year 1; however, little difference in LEA occurred between boars and barrows in year 2 (year × gender interaction, $P < .01$). Finally, LEA was increased more for boars than barrows when lysine concentration of the diet was increased (gender × lysine regimen interaction, $P < .06$).

Despite the mentioned trends for improved rate and (or) efficiency of gain for the main effects of barrows vs boars, moderate vs high lysine concentrations, and the 220 vs 260 lb slaughter weight, many noteworthy interactions occurred. For example, the pigs in year 1 (medium-lean growth) had greater overall ADG when left as boars with no change in ADG for year 2 (high-lean growth) pigs left as boars (year × gender interaction, $P < .03$). Also, the F/G of pigs from year 2 (high-lean growth) responded more to the high lysine regimen than did the F/G of pigs from year 1 (year × lysine regimen interaction, $P < .03$). Finally, F/G for year 2 boars was improved with the high lysine regimen, whereas barrows from year 2 and barrows from year 1 responded little to the high lysine regimen (year × gender × lysine interactions, $P < .01$ and .09, respectively for the finishing period and overall F/G data). The response seems logical because the amino acid demands would be greater for high-lean growth (year 2) boars than for barrows or the boars of a medium-lean growth (year 1) potential.

In conclusion, the year 2 (high-lean growth) boars fed a high lysine regimen and slaughtered at 220 lb were 39% more efficient, had 49% less avg backfat thickness, and went to market 35 days sooner than the control barrows - (medium-lean gain, fed moderate lysine regimen, and slaughtered at 260 lb). Thus, it seems likely that use of boars of a high-lean growth genotype will help the swine industry offer an extremely lean product to consumers with minimum cost of production. Also, the young age (130 d old) when these pigs were slaughtered would be likely to minimize concerns about development of boar odor. Alternatively, boars could be fed to heavier weights and their carcasses used for processed meat products, with gilt carcasses used to meet the lower demand for the fresh-meat trade.

Table 1. Diet Composition, %

	Nursery[a]			Grower[b]		Finisher[c]	
Ingredient	PH 1	PH 2	PH 3	Moderate[d]	High[d]	Moderate	High
Corn	40.07	56.54	54.28	67.72	52.99	77.85	63.12
Soybean meal	17.21	16.78	37.80	25.20	40.26	17.43	32.49
Dried whey	20.00	15.00	--	--	--	--	--
Dried-skim milk	5.00	--	--	--	--	--	--
SD plasma	10.00	--	--	--	--	--	--
SD blood meal	--	1.50	--	--	--	--	--
Fishmeal	1.00	3.00	--	--	--	--	--
Soybean oil	3.00	3.00	3.00	4.00	4.00	2.00	2.00
Dicalcium phosphate	1.58	1.56	2.24	1.65	1.33	1.22	.90
Limestone	.55	.58	.59	.68	.67	.75	.74
Salt	--	--	.35	.35	.35	.35	.35
Vit/Min/AA/Ab[e]	1.59	2.04	1.74	.40	.40	.40	.40

[a]The nursery pigs were fed the same diets for d 0 to 10 (1.6% lysine), 10 to 24 (1.4% lysine), and 24 to 38 (1.35% lysine).

[b]The grower diets were fed from 72 to 150 lb.

[c]The finisher diets were fed from 150 lb to the targeted slaughter weights of 220 or 260 lb.

[d]Moderate diets were formulated to .9 and .7% lysine and high diets were formulated to 1.3 and 1.1% lysine.

[e]Supplied 150 g/ton of apramycin for d 0 to 24 and 50 g/ton of carbadox for d 24 to 38, and 40 g/ton of tylosin for the growing and finishing phases [synthetic amino acids (AA) were not included in the growing/finishing phases].

Table 2. Growth Performance of Nursery Pigs[a]

	Year 1		Year 2			Contrasts[b]		
Item	Barrow	Boar	Barrow	Boar	CV	1	2	3
d 0 to 10								
ADG, lb	.69	.67	.78	.81	10.7	.02	--[c]	--
ADFI, lb	.61	.63	.80	.86	8.8	.001	.09	--
F/G	.88	.94	1.03	1.06	12.9	.01	--	--
d 10 to 24								
ADG, lb	.80	.79	1.16	1.12	10.3	.001	--	--
ADFI, lb	1.13	1.11	1.51	1.50	7.4	.001	--	--
F/G	1.41	1.41	1.30	1.34	6.4	.001	--	--
d 24 to 38								
ADG, lb	1.40	1.36	1.53	1.50	9.4	.001	--	--
ADFI, lb	2.12	1.98	2.30	2.16	9.6	.003	.05	--
F/G	1.51	1.46	1.51	1.45	4.6	--	.02	--
d 0 to 38								
ADG, lb	.99	.97	1.20	1.18	7.6	.001	--	--
ADFI, lb	1.36	1.30	1.61	1.58	7.3	.001	--	--
F/G	1.37	1.34	1.34	1.34	3.2	--	--	--

[a]A total of 200 weanling pigs (five pigs/pen and 20 pens per treatment) with an average initial wt of 11.7 lb and an average final wt of 52.8 lb.

[b]Contrasts were: 1) year; 2) barrows vs boars; 3) year by gender interaction.

[c]Dashes = P>.10.

Table 3. Growth Performance of Barrows and Boars during the Growing-Finishing Phase[a]

	Barrows				Boars				
	Moderate		High[b]		Moderate		High		
Item	220	260	220	260	220	260	220	260	CV
Grower									
ADG, lb									
Year 1[c]	1.91	2.00	1.83	2.00	1.95	1.96	1.96	1.92	
Year 2[d]	2.13	2.23	2.27	2.44	2.28	2.20	2.29	2.28	
Average	2.02	2.12	2.05	2.22	2.12	2.08	2.13	2.10	7.2
ADFI, lb									
Year 1	4.30	4.75	4.54	4.88	4.35	4.39	4.38	4.49	
Year 2	5.07	4.92	4.70	5.20	4.85	4.80	4.12	4.53	
Average	4.69	4.84	4.62	5.04	4.60	4.60	4.25	4.51	8.8
F/G									
Year 1	2.25	2.38	2.48	2.44	2.23	2.24	2.23	2.34	
Year 2	2.38	2.21	2.07	2.13	2.13	2.18	1.80	1.99	
Average	2.32	2.28	2.25	2.27	2.17	2.21	2.00	2.15	10.5
Finisher									
ADG, lb									
Year 1	2.03	1.85	2.17	1.98	2.14	2.08	2.21	1.99	
Year 2	2.38	2.16	2.20	2.07	1.96	1.99	2.16	2.07	
Average	2.21	2.01	2.19	2.03	2.05	2.04	2.19	2.03	10.3
ADFI, lb									
Year 1	6.33	5.82	5.85	6.17	5.83	5.64	5.52	5.44	
Year 2	6.19	6.31	5.85	6.33	5.37	5.23	4.87	5.10	
Average	6.26	6.07	5.85	6.25	5.60	5.44	5.20	5.27	8.7
F/G									
Year 1	3.12	3.15	2.77	3.12	2.72	2.71	2.50	2.75	
Year 2	2.60	2.92	2.66	3.06	2.74	2.63	2.25	2.48	
Average	2.83	3.02	2.67	3.08	2.73	2.67	2.37	2.62	10.0
Overall									
ADG, lb									
Year 1	1.96	1.93	1.95	1.99	2.04	2.03	2.08	1.93	
Year 2	2.25	2.19	2.26	2.22	2.15	2.08	2.22	2.16	
Average	2.11	2.06	2.11	2.11	2.10	2.06	2.15	2.05	6.8
ADFI, lb									
Year 1	5.19	5.34	5.07	5.60	5.04	5.12	4.93	5.00	
Year 2	5.51	5.74	5.23	5.88	5.10	5.24	4.45	4.88	
Average	5.35	5.54	5.15	5.74	5.07	5.18	4.69	4.94	7.0
F/G									
Year 1	2.65	2.77	2.60	2.81	2.47	2.52	2.37	2.59	
Year 2	2.45	2.62	2.31	2.65	2.37	2.52	2.00	2.26	
Average	2.54	2.69	2.44	2.72	2.41	2.51	2.18	2.41	7.2
Age, days[e]									
Year 1	147	165	148	167	145	163	145	164	
Year 2	128	155	130	156	129	156	130	156	
Average	138	160	139	162	137	160	138	160	1.4

[a]A total of 160 barrows and boars (initial weight of 71 lb) was used.
[b]Moderate (.9 and .7% lysine) vs high (1.3 and 1.1% lysine).
[c]Rotational cross (Yorkshire × Chester White × Duroc × Hampshire) before repopulation.
[d]Terminal cross (PIC line 326 boars × C15 sows) after repopulation.
[e]Age = days from birth to slaughter weight.

Table 4. Probability Values for the Growth Performance Data[ab]

Item	Year (1)	Gender (2)	Lys (3)	Swt (4)	1×2	1×3	1×4	2×3	1×2×3
Grower									
ADG	.001	--[c]	--	NA[d]	--	.05	NA	--	--
ADFI	.09	.01	--	NA	--	.03	NA	--	--
F/G	.02	.01	--	NA	--	.01	NA	--	--
Finisher									
ADG	--	--	--	.01	.01	--	--	--	.03
ADFI	--	.001	.04	--	.03	--	--	--	--
F/G	.01	.001	.02	.01	--	--	--	--	.01
Overall									
ADG	.001	--	--	--	.03	--	--	--	--
ADFI	--	.001	.06	.001	.02	.10	--	.06	--
F/G	.06	.001	.02	.001	--	.03	--	--	.09
Age	.001	.01	.10	.001	.01	--	.001	--	--

[a]Contrasts were: 1) year; 2) gender (barrows vs boars); 3) lysine regimen (moderate vs high) and; 4) slaughter weight (220 vs 260 lb).
[b]All two-, three-, and four-way interactions were tested, but only those with response criteria having a probability value of .10 or less are included in this table.
[c]Dashes = P>.10.
[d]Not applicable (i.e., slaughter wt treatments were applied at the end of the finishing phase).

Table 5. Carcass Characteristics of Barrows and Boars[a]

	Barrows				Boars				
	Moderate[b]		High[b]		Moderate		High		
Item	220	260	220	260	220	260	220	260	CV
Carcass									
Dressing, %									
Year 1[c]	72.9	75.6	74.4	75.2	72.8	73.7	72.3	73.4	
Year 2[d]	73.8	74.9	73.7	73.9	72.8	73.1	72.7	72.7	
Average	73.4	75.3	74.1	74.6	72.8	73.4	72.5	73.1	1.4
Average BF, in									
Year 1	1.31	1.56	1.32	1.47	1.14	1.31	1.03	1.22	
Year 2	.98	1.15	.99	1.08	.89	.97	.76	.87	
Average	1.15	1.36	1.16	1.28	1.02	1.14	.90	1.05	11.1
10th rib BF, in									
Year 1	1.29	1.64	1.31	1.52	1.19	1.35	.96	1.20	
Year 2	.85	.87	.67	.79	.67	.74	.56	.56	
Average	1.07	1.26	.99	1.16	.93	1.05	.76	.88	14.4
Loin eye area, sq in									
Year 1	5.49	5.88	5.32	5.59	5.42	6.16	6.01	6.35	
Year 2	6.08	6.87	6.54	7.15	5.90	6.37	6.57	7.00	
Average	5.79	6.38	5.93	6.37	5.66	6.27	6.29	6.68	8.4
FFLI, %									
Year 1	45.4	44.1	45.7	45.4	47.1	46.3	47.4	47.1	
Year 2	48.8	48.1	48.7	49.2	49.8	49.9	50.5	50.8	
Average	47.1	46.1	47.2	47.3	48.5	48.1	49.0	49.0	2.5

[a]A total of 160 barrows and boars (initial weight of 71 lb) was used.
[b]Moderate (.9 and .7% lysine) vs high (1.3 and 1.1% lysine).
[c]Rotational cross (Yorkshire × Chester White × Duroc × Hampshire)
[d]Terminal cross (PIC line 326 boars × C15 sows).

Table 6. Probability Values for the Carcass Data[a]

Item	Year (1)	Gender (2)	Lys (3)	Swt (4)	1×2	1×3	1×4	2×3	1×2×3
Dressing %	--[b]	.001	--	.001	--	--	.05	--	--
Average BF	.001	.001	.01	.001	--	--	--	--	--
10th rib BF	.001	.001	.01	.001	--	--	.01	--	--
LEA	.01	--	.02	.001	.01	.08	--	.06	--
FFLI	.001	.001	.02	--	--	--	--	--	--

[a]Contrasts were: 1) year; 2) gender (barrows vs boars); 3) lysine regimen (moderate vs high); 4) slaughter weight (220 vs 260 lb).
[b]All two-, three-, and four-way interactions were tested, but only those with response criteria having a probability value of .10 or less are included in this table.
[c]Dashes = P>.10.