Estimating the Lysine Requirements of Halothane Carrier Sired Barrows and Gilts

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Introduction

The use of high lean genetics in pork production has become commonplace. Incorporating these new genetic lines requires producers to change management practices and nutrition programs. Because feed costs can account for approximately two-thirds of the cost of production, it is necessary to maximize production efficiency by meeting the nutritional requirements of the pig. These lean genotypes can be created using halothane positive or carrier terminal sires. The objectives of this trial were to estimate the lysine requirements of halothane carrier sired pigs using growth performance, carcass characteristics, growth curves, and blood urea nitrogen concentrations.

Materials and Methods

One hundred twenty-six barrows (B) with an initial weight of 68.8 lb were penned 7 pigs per pen (7.5 ft^2/pig), and 72 gilts (G) with an initial weight of 69.0 lb were penned 6 pigs per pen (10 ft^2/pig). The halothane carrier sired barrows and gilts were fed as a mixed carrier and negative pool, simulating on farm use of a carrier sire. Pigs and feeders were weighed weekly to determine average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency. The diets were formulated on a total lysine basis while maintaining an ideal amino acid ratio. Three dietary lysine sequences (L, M, and H) were phase fed from initial weight to 100 lb (P1), 100 to 150 lb (P2), 150 to 200 lb (P3), and 200 lb to market weight (P4). Treatments were arranged as a 2 x 3 factorial with two sexes and three dietary lysine sequences (Table 1).

Pigs were ultrasonically scanned at diet changes and market weight to generate lean and lipid accretion curves, and to determine 10th and last rib backfats and loin eye area (LEA). From the ultrasound measurements, percent lean was calculated. Four pigs per pen were bled after a 2-hour fast at the start of the trial and two weeks after diet changes. Pigs were also bled during ad-libitum feeding two weeks after diet changes. All blood samples were assayed to determine blood urea nitrogen levels (BUN).

Results and Discussion

Growth performance and carcass characteristics are given in Table 2. From initial weight to 100 lb, there were no statistical differences among the dietary treatments and sexes (P>.20). During the second dietary sequence, barrows had greater ADG (P<.003) and ADFI (P<.0003) than gilts. Also during P2, pigs on the L diet had 4% greater ADFI than the pigs on the M and H diets (P<.10). In the next phase, P3, barrows again had greater ADG (P<.02) and ADFI (P<.002) compared to gilts. This same trend continued in P4, with barrows gaining 0.2 lb/day more (P<.008) and consuming 0.9 lb/day more (P<.004) than gilts.

Gilts had less last rib and 10th rib backfat depths than barrows (P<.0001). Gilts also had .36 in^2 larger LEA compared to barrows (P<.0006). These differences in backfat depth and LEA resulted in gilts having 3.1% more lean than barrows (P<.0001).

Growth curves were generated using augmented allometric equations. Both barrows and gilts responded similarly to all three dietary lysine sequences (Figures 1 to 4). Based on the data, estimated lysine requirement curves were generated for barrows and gilts using the average of the three empty body protein and lipid accretion curves. The lysine requirement curves for each sex (Figure 5) demonstrate that barrows have a higher lysine requirement early in the grow-finish period, while gilts maintain a higher lysine requirement during late finishing.

The use of BUN concentrations has been an effective tool for scientists to evaluate the lysine requirements of pigs; however, its use in production settings has not been studied to a great extent. Therefore, samples were collected during ad-libitum feeding in addition to fasted samples (Table 3). The blood samples that were collect during ad-libitum feeding indicated that gilts had lower BUN levels than barrows during P1 (P<.10) and P3 (P<.0035). The samples collected after a 2-hour fast yielded similar results to the ad-libitum samples. Gilts had lower BUN levels during P1 (P<.043), P2 (P<.0001), and P3 (P<.0023) compared to barrows. During all phases, there were linear responses in BUN, with BUN increasing with increasing dietary lysine (P<.008). Both ad-libitum and fasted samples were alike; nevertheless, there was more variation in the samples collected during ad-libitum feeding than in those collected after a 2-hour fast.

Applications

The growth and carcass data indicate that there were no statistical differences due to the dietary lysine sequences fed in this trial. This suggests that the lysine sequences used were greater than the minimum requirements for these pigs. Blood urea nitrogen concentrations indicate that this may still prove to be a valuable tool in production settings if more pigs are sampled to reduce the variation in the data. The estimated lysine requirements curves indicate the minimum lysine intake for the halothane carrier sired barrows to be 17.0 g/day for P1, 17.1 g/day for P2, 15.9 g/day for P3, and 12.7 g/day for P4, and for the gilts to be 15.5 g/day for P1, 15.8 g/day for P2, 15.5 g/day for P3, and 13.8 g/day for P4. In order to account for ingredient and mixing variability, producers need to add 10% to these values in practical feed formulation.

Table 1. Diet sequences[a].

	Total Lysine, %		
Phase) weight range	Low (L)	Medium (M)	High (H)
1) Initial weight to 100 lb	1.12	1.26	1.41
2) 100 to 150 lb	1.02	1.16	1.30
3) 150 to 200 lb	0.80	0.90	1.00
4) 200 lb to market weight[b]	0.55/0.65	0.65/0.75	0.75/0.90

[a] Standard corn-soy diets with 3% added fat. Phase 1 and 2 diets contained 0.75 % Ca and 0.65 % P. Phase 3 and 4 diets contained 0.65 % Ca and 0.55 % P.

[b] The first number represents the barrow diet and the second number represents the gilt diet.

Table 2. Growth performance and carcass characteristics[a].

Sex:	Gilts				Barrows				Significance		
Lysine Sequence:	Low	Med	High	SE	Low	Med	High	SE	Sex	Lysine	Lys x Sex
Initial weight, lb	69.6	68.6	68.7	4.15	69.1	68.8	68.2	3.34	.94	.96	.99
Final weight, lb	235.8	229.0	231.9	4.91	254.5	248.7	247.2	3.95	.0003	.28	.87
Day 0 to 100 lb											
ADG, lb	1.88	1.91	1.78	.05	1.79	1.81	1.84	.04	.34	.58	.23
ADFI, lb	3.98	3.80	3.80	.15	3.72	3.72	3.66	.12	.24	.66	.80
F/G	2.11	1.99	2.12	.06	2.08	2.06	1.99	.05	.62	.49	.23
Lysine intake, g/d	20.2	21.7	24.3		18.9	21.3	23.4				
100 to 150 lb											
ADG, lb	1.68	1.62	1.69	.05	1.88	1.79	1.77	.04	.003	.24	.41
ADFI, lb	4.66	4.42	4.62	.15	5.30	4.96	5.14	.12	.0003	.10	.87
F/G	2.76	2.72	2.74	.07	2.81	2.78	2.90	.06	.14	.51	.62
Lysine intake, g/d	21.6	23.3	27.2		24.5	26.1	30.3				
150 to 200 lb											
ADG, lb	1.78	1.61	1.67	.10	1.97	1.90	1.83	.08	.02	.27	.76
ADFI, lb	5.54	5.28	5.47	.28	6.41	6.25	6.17	.23	.002	.67	.86
F/G	3.13	3.29	3.30	.12	3.27	3.29	3.37	.09	.51	.44	.82
Lysine intake, g/d	20.1	21.6	24.8		23.3	25.5	28.0				
200 lb to market											
ADG, lb	1.48	1.47	1.51	.09	1.74	1.67	1.70	.07	.008	.86	.91
ADFI, lb	5.55	5.69	5.86	.33	6.63	6.66	6.55	.27	.004	.92	.79
F/G	3.73	3.88	3.89	.14	3.81	3.99	3.85	.11	.67	.40	.82
Lysine intake, g/d	16.4	19.4	23.9		16.5	19.6	22.3				
Last rib BF, in	.58	.58	.59	.03	.77	.72	.74	.02	.0001	.68	.70
10th rib BF, in	.72	.69	.72	.04	.96	.94	.92	.03	.0001	.14	.52
LEA, in^2	6.29	5.95	6.20	.13	5.73	5.87	5.78	.10	.0006	.66	.099
Lean, %	53.69	53.17	53.63	.58	50.13	50.62	50.56	.44	.0001	.91	.60

[a] Growth performance data were adjusted for differences in initial weight, and carcass characteristics were adjusted for final weight.

Table 3. Blood urea nitrogen concentrations.

Sex:	Gilts				Barrows				Significance		
Lysine Sequence:	Low	Med	High	SE	Low	Med	High	SE	Sex	Lysine	Lys x Sex
Blood Urea Nitrogen, mg/dl											
Fasted day 0	17.83	17.89	18.94	1.14	16.95	16.94	16.57	.93	.11	.93	.73
Ad-lib 100 lb	19.22	19.72	29.16	2.04	20.51	24.19	31.18	1.66	.10	.0001 linear	.67
Fasted 100 lb	21.76	23.32	26.13	1.26	22.87	25.70	28.69	1.03	.043	.0007 linear	.79
Ad-lib 150 lb	18.09	23.29	25.45	1.63	20.40	25.24	27.11	1.33	.12	.0003 linear	.97
Fasted 150 lb	17.13	18.24	20.49	1.41	20.58	23.40	26.26	1.15	.0001	.0066 linear	.65
Ad-lib 200 lb	16.42	19.67	22.56	2.06	22.35	22.41	28.83	1.68	.0035	.0075 linear	.59
Fasted 200 lb	14.92	19.14	20.02	1.41	18.22	22.07	24.48	1.15	.0023	.0006 linear	.82
Ad-lib 250 lb	14.40	15.20	18.98	1.13	14.51	17.69	18.47	.92	.41	.0015 linear	.32
Fasted 250 lb	15.15	18.06	23.97	1.30	16.41	18.42	21.13	1.06	.68	.0001 linear	.21

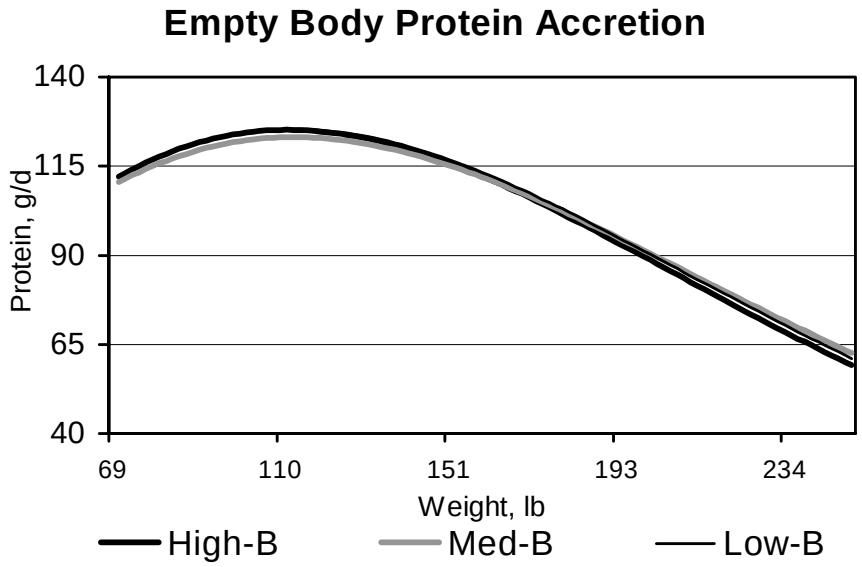

Figure 1. Empty body protein accretion curves of halothane carrier sired barrows.

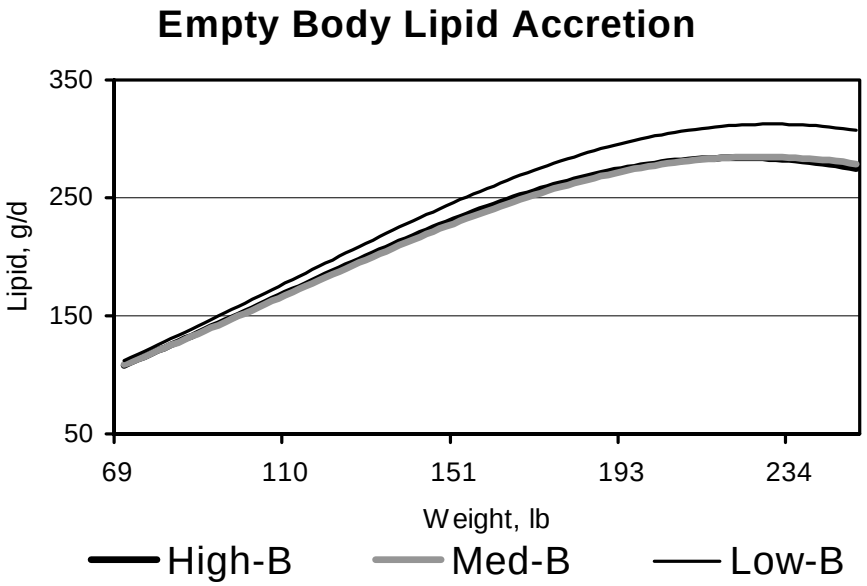

Figure 2. Empty body lipid accretion curves of halothane carrier sired barrows.

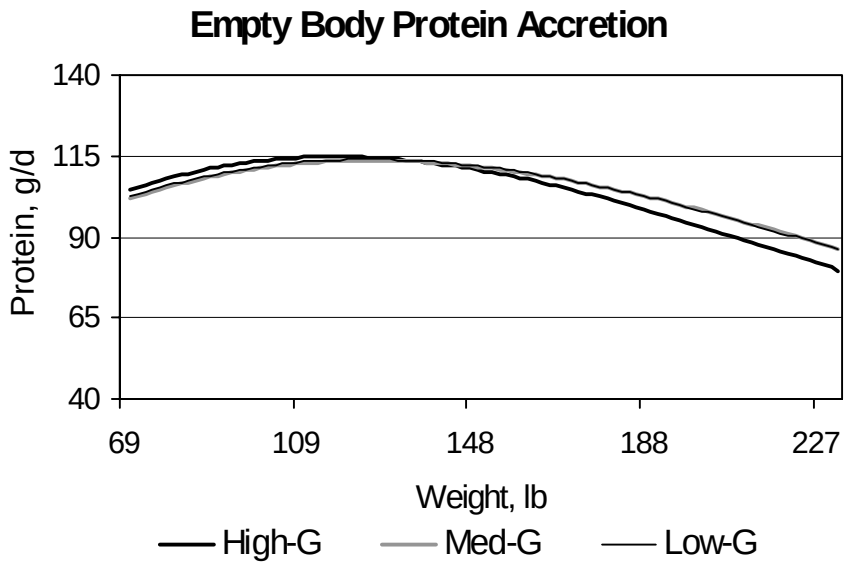

Figure 3. Empty body protein accretion curves for halothane carrier sired gilts.

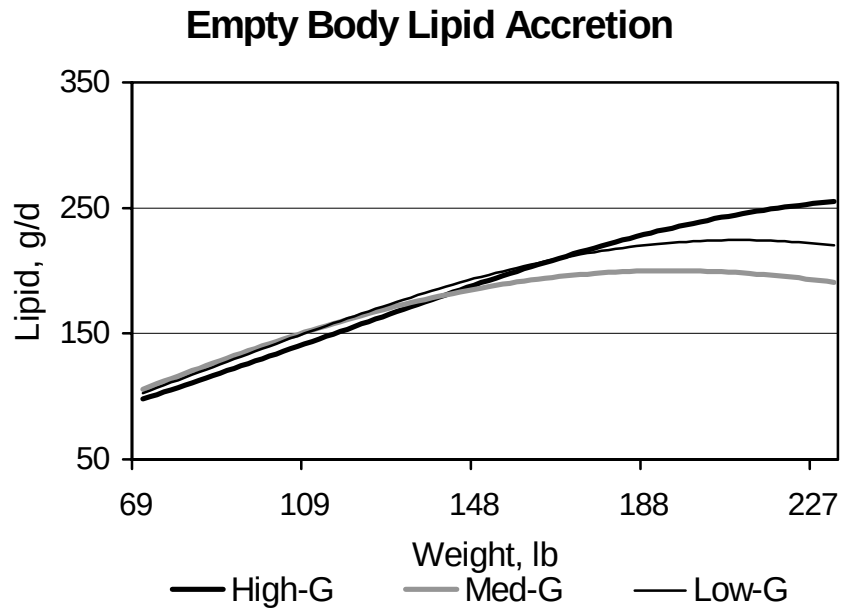

Figure 4. Empty body lipid accretion curves for halothane carrier sired gilts.

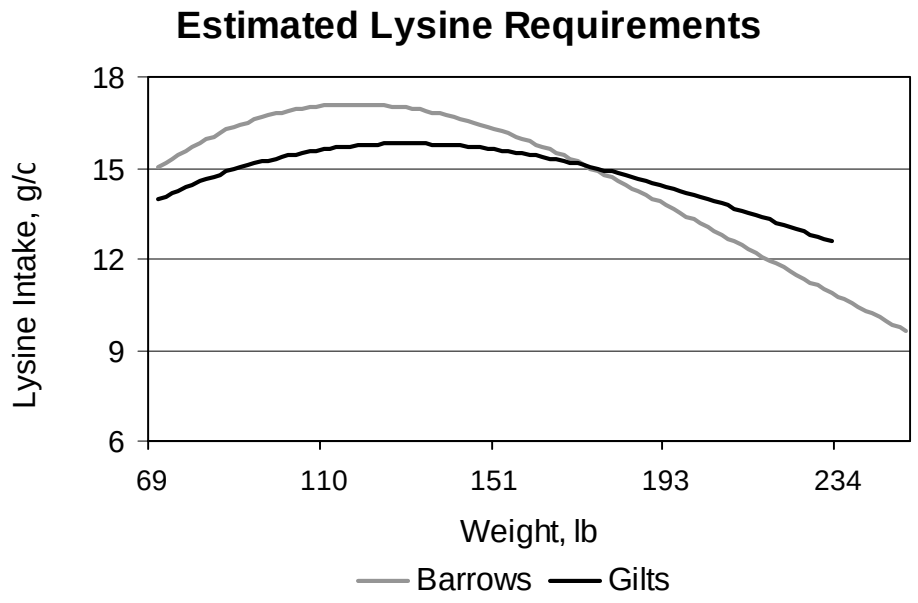

Figure 5. Estimated lysine requirements of halothane carrier sired barrows and gilts. Curves are based on the following equation:
Lysine Intake = (((0.1*(protein$^{0.95}$))+(protein accretion*0.068/0.65))/0.8.