Effect of Gilt Developer Diets Differing in Standard Ileal Digestive Lysine Concentrations on Age and Growth Performance at First Heat-No-Service and Mating

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Summary and Implications

An experiment was conducted to determine the optimum dietary lysine concentration for reproductive performance and optimum growth rate at first heat-no-service (HNS) and mating of replacement gilts. Three grower and finisher diets were formulated to contain low lysine (0.68 and 0.52% standard ileal digestible (SID) lysine), medium lysine (0.79 and 0.60% SID lysine), and high lysine (0.90 and 0.68 % SID lysine) at data recording day (142, 160 and 200 d of age). Trial gilts (n=2,541) were moved to breeding farms for age and performance measurement (age, body weight, caliper, flank-to-flank, backfat, loin depth, and fat-free-lean). Fixed effects of dietary lysine treatment, farm, week of birth, and covariate 100 d were included in the model and were analyzed using Proc Mixed. Dietary lysine treatment had significant influence on growth performance at natural HNS and HNS induced with PG600 ($P<0.05$). Gilts fed the high dietary lysine treatment had greatest impact on growth traits ($P<0.05$) for both gilts having natural HNS (135.3±0.8 kg) and gilts induced with PG600 (140.6±1.0 kg) when compared to gilts fed the other treatments and expressing estrus in the same manner. Moreover, the high dietary lysine level had the desired effect on age (227.7±1.0 d) and growth performance (140.7±0.8 kg) at first mating. The results indicated that high lysine diet may useful to impact growth traits at first HNS and mating when fed to developing gilts from 100 to 200 d of age.

Introduction

Interest in gilt development nutritional programs has increased dramatically in recent years due to decreasing sow longevity in swine production systems. Optimum growth rates for developing gilts have been reported to be associated with improved reproductive performance. Efforts to improve sow longevity should be directed at replacement gilt management by providing adequate housing including floor space and feeding regimes to achieve optimum growth and body composition before the gilts enter the breeding herd. The Animal Science Committee of the National Pork Board commissioned studies to develop *ad libitum* fed gilt development diets that result in reduced growth rates and/or altered body composition for U.S. pig production. The first study evaluated three lysine levels: low lysine (0.68 and 0.52% SID lysine), medium lysine (0.79 and 0.60% SID lysine), and high lysine (0.90 and 0.68 % SID lysine) at 100 to 200 d of age. However, the effects of differing lysine dietary levels on age and growth performance to the gilt's first heat-no-service (HNS) event and first mating have not been assessed based on a search of the scientific literature.

The objective of this study was to evaluate the effect of three dietary treatments that differed in SID lysine concentrations on the gilt's age and growth performance at their first HNS event and first mating on maternal line gilts.

Materials and Methods

Crossbred Large White (LW) x Landrace (LR) gilts (n=2,960) were useed in this study. They originated from Murphy Brown LLC facilities in Milford, Utah. These gilts entered to the gilt development unit (GDU) and were fed grower and finisher diets formulated to provide 1.) low lysine 0.68 and 0.52 % (3.1 and 3.2 kg/Mcal), 2.) medium lysine 0.79 and 0.60 % (3.2 and 3.2 kg/Mcal), and 3.) high lysine 0.90 and 0.68 % (3.3 and 3.3 kg/Mcal) SID lysine levels from 100 to 142 d for grower diets (Phase 1) and 143 to 200 d of age for finisher diets (Phase 2). The 2,541 crossbred LW x LR gilts were moved to a breeding herd and were evaluated for age and growth traits at first HNS and mating. Gilts at 160 d of age were exposed daily to vasectomized boars for a 10 min period and observed for behavioral estrus expression at GDU. At 220 d of age, all gilts not expressing a standing estrus were injected with PG600 (MERCK Animal Health, USA) and observed for 1 wk to determine their estrus response.

Individual BW for each gilt was recorded using digital scale (Digi-Star SW4600EID Digital RFID, VID Recording scale; Digi-Star LLC, Fort Atkinson, WI). Body condition scores were assigned by placing the caliper at the last rib on the gilts back. Flank-to-flank measurement evaluated the distance between the anterior sides of the hide legs using a cloth tape. Backfat, and loin depth were evaluated applying real-time ultrasonography the probe to the last rib. Fat-free-lean meat content was calculated using the equation: 0.379 x 2 [gender of pig; in case gilt =2] – [0.649 x 10^{th} rib of fat depth (mm)] + [0.841 x 10^{th} rib loin muscle depth (cm^2)] + [0.132 x live BW (kg)] – 0.243. Lifetime growth rate (LGR) at data recording days was measured using a standard formula from birth to HNS.

Data were analyzed using a generalized linear model (GLM; SAS version 9.4). Models implemented to evaluate age and growth performance included fixed effects: dietary lysine levels, farm, and week of birth. Weight at 100 d as a linear and quadratic covariate effect was included for data analysis. These fixed effects were evaluated for differences at P value of 0.05 or less when the fixed effect was a significant source of model variation. The individual means for each level of each fixed effect were separated using the PDIFF option.

Results and Discussion

The average age was 201±1.1 d for entry to the breeding herd, 205± 9.1 d for natural HNS and 229±5.2 d for first HNS with induced PG600. Age of gilts at entry for low, medium, and high lysine treatments were 200.9±1.1, 201.7±1.1, and 202.8±1.0 d, respectively (P>0.05). Average age at first HNS and induced PG600 and least square means for growth performance in each treatment represent in Table 1. The dietary lysine treatment had a significant influence on growth performance to the gilt's first HNS event (P<0.01). Gilts fed high lysine had progressively greater growth performance when compared to gilts fed medium and low lysine treatments. However, dietary treatments had no impact on the gilt's age at first natural HNS or gilt's induced with PG600.

Fixed effects in the model for age and growth at first mating were similar with the results for performance to the gilt's first HNS event. Fixed effect for dietary lysine treatments was a significant source of variation in the model evaluating gilt's growth performance at first mating (Table 2). Average of age at first mating was 230.4±4.3 d. Age at first mating for gilts fed the high lysine treatment was favorably fewer than others (P<0.05). In addition, gilts fed high lysine had significantly greater growth traits when compared to gilts fed medium and low lysine treatments (P<0.05).

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Table 1. Gilt age and growth performance least square means (±SE) at first heat no service (HNS) from maternal line[1] gilt's fed diets (*ad libitum*) with different dietary lysine treatments.

Traits	Dietary treatment[2]		
	Low	Medium	High
Natural HNS			
Age (d)	205±0.8	205±0.8	205±0.8
BW (kg)	130.6±0.9[a]	132.7±0.8[b]	135.3±0.8[b]
Caliper score	10.4±0.6[a]	10.8±0.5[b]	12.0±0.5[c]
Flank-to-flank (cm)	85.4±0.4[a]	86.4±0.3[b]	88.9±0.3[c]
Backfat (mm)	14.7±0.2[a]	15.1±0.2[b]	15.8±0.2[c]
Loin depth (cm)	5.1±0.04[a]	5.3±0.05[b]	5.5±0.04[c]
Fat-free-lean (kg)	50.1±0.5[a]	51.8±0.5[b]	53.6±0.4[c]
LGR[3] (kg/d)	0.55±0.003[a]	0.56±0.003[b]	0.60±0.004[c]
HNS induced with PG600			
Age (d)	229±0.9	230±0.9	228±0.9
BW (kg)	135.8±0.9[a]	135.7±1.0[a]	140.6±1.0[b]
Caliper score	11.3±0.4[a]	11.9±0.4[b]	12.8±0.4[c]
Flank-to-flank (cm)	84.6±0.3[a]	85.4±0.3[b]	86.4±0.3[c]
Backfat (mm)	13.0±0.4[a]	13.1±0.4[a]	13.9±0.4[b]
Loin depth (cm)	4.7±0.09[a]	4.9±0.09[b]	5.2±0.09[c]
Fat-free-lean (kg)	47.3±0.9[a]	48.8±0.9[b]	51.9±0.9[c]
LGR (kg/d)	0.51±0.004[a]	0.51±0.004[a]	0.54±0.004[b]

[1] Large White x Landrace gilts

[2] Low (low SID lysine; 0.68%, phase 1; 0.52%, phase 2), Medium (medium SID lysine; 0.79%, phase 1; 0.60%, phase 2), and High (high SID lysine; 0.90%, phase 1; 0.68%, phase 2)

[3]LGR=lifetime growth rate ($\frac{\text{BW at HNS (kg)} - \text{BW at birth(kg)}}{\text{Age of gilt (d)}}$)

[a-c] within rows, significant difference between dietary lysine treatments ($P<0.05$).

Table 2. Gilt age and growth traits least square means (±SE) at first mating from maternal line[1] gilt's fed diets (*ad libitum*) with different dietary lysine treatments.

Traits	Dietary treatment[2]		
	Low	Medium	High
Age (d)	232.9±1.1[a]	230.5±1.1[a]	227.7±1.0[b]
BW (kg)	135.7±0.6[a]	137.2±0.7[b]	140.7±0.8[c]
Caliper score	12.0±0.1[a]	12.3±0.1[b]	13.0±0.1[c]
Flank-to-flank (cm)	89.6±0.2[a]	89.8±0.2[b]	90.8±0.2[c]
Backfat (mm)	11.4±0.2[a]	11.4±0.2[a]	12.2±0.2[b]
Loin depth (cm)	5.1±0.1[a]	5.2±0.1[a]	5.4±0.1[b]
Fat-free-lean (kg)	51.2±0.4[a]	52.4±0.4[b]	55.2±0.4[c]

[1] Large White x Landrace gilts

[2] Low (low SID lysine; 0.68%, phase 1; 0.52%, phase 2), Medium (medium SID lysine; 0.79%, phase 1; 0.60%, phase 2), and High (high SID lysine; 0.90%, phase 1; 0.68%, phase 2)

[a-c] within rows, significant difference between dietary lysine treatments ($P<0.05$).