

Effect of Deviations from Predicted Lactation Feed Intake on Reproductive Performance in F1 Sows

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Summary and Implications

The objective of this study was to quantify negative deviations from predicted lactation feed intake (LFI) values and the effect of negative deviations on reproductive performance. Daily lactation feed intake values (LFI) were recorded on 10,716 litters farrowed by purebred Yorkshire, Landrace and F1 (Yorkshire x Landrace) sows with an average lactation length of 18.5 days. Daily LFI values were predicted for each litter using the PROC HPMIXED procedure in SAS. An internally studentized residual ≤ -1.71 was characterized as a negative deviation from predicted LFI value (DEV). Total DEV during lactation ranged from 0 occurrences up to 14 negative deviations. However, the occurrence of more than 5 deviations during lactation was rare, and reproductive performance was not statistically affected by additional negative deviations. Twenty-one day litter weaning weight decreased with each additional negative deviation until at least 3 negative deviations occurred in which litter weaning weight remained at a constant value for litters produced by purebred and F1 sows. Wean-to-service interval remained constant when 0, 1, or 2 negative deviations occurred but when the number of negative deviations during lactation reached at least 3, wean-to-service interval began to increase. Limiting the number of DEV during lactation increases the likelihood that a sow will reach her reproductive potential.

Introduction

Reduced levels of feed intake during lactation restrict the sow's ability to provide adequate nutrients for litter growth and maintain body condition for efficient reproductive performance and lifetime productivity. During lactation, feed intake and body reserves are the only sources of nutrients available for maintenance and milk production. However, feed intake during lactation is frequently inadequate and does not meet the nutrient requirements of the litter, which results in mobilization of body reserves to maintain milk production levels. Increasing feed intake during lactation is one solution to minimize the mobilization of body reserves and improve sow and litter performance.

Materials and Methods

Animals: Daily lactation feed intake records (LFI) on 10,716 parity records were collected from purebred Yorkshire (n = 1,587 parity records) and Landrace (n = 2,197 parity records) sows, and Landrace x Yorkshire (n = 6,932 parity records) F1 sows. Data were recorded from sows in 3 production units representing a nucleus, multiplier, and commercial farm within the same genetic flow from January 2007 through March 2011. Parity records from sows of parity greater than 10 or lactation length (LL) less than 15 days or more than 25 days were removed from the data set. Collection of daily LFI records began post farrowing on sows housed in individual stalls in a totally enclosed confinement environment. Purebred sows were hand fed 5 times per day and F1 sows were hand fed two times per day. Remaining feed was estimated the following morning and subtracted from the previous day's total to calculate daily LFI values. Sows were fed to appetite throughout lactation with increased feed availability when all feed was eaten during the previous feeding. Litter size (LS) was recorded as number of pigs nursing after cross-fostering (with-in 24 hours post farrowing) occurred. Number of pigs weaned and litter weaning weight were recorded at time of weaning. Wean-to-first service interval (WTSI) was recorded on sows that remained in the breeding herd.

Statistical Analysis: Daily LFI values were predicted using a mixed model (HPMIXED procedure in SAS) which included fixed effects of breed, season (Winter: December, January and February; Spring: March, April and May; Summer: June, July and August; Fall: September, October and November), parity group (PG), day of lactation, and interactions of day of lactation with PG. The model also included a covariate of litter size after cross fostering. Random effects included litter, contemporary group (herd-year-month), dam, and sire nested within breed. Initial analysis included parity as a fixed effect; however, there were no significant differences ($P > 0.05$) in daily LFI after parity 4 and the final model included 4 categories for the effect of PG: parity 1, 2, 3 and ≥ 4 . Least squares means for observed LFI for each day of lactation were used to quantify the LFI curves through day 22 of lactation (Figure 1). Internally studentized residuals (SR) were produced by the HPMIXED procedure in SAS for every predicted daily LFI value. In the present study a SR ≤ -1.71 , equivalent to observed LFI values that were at least 1.92 kg less than the corresponding predicted daily LFI value, was categorized as a significant negative deviation from predicted LFI values. The effect of a DEV during lactation on LW21, wean-to-first service interval (WTSI) and average daily feed intake

during lactation (ADFI) were estimated by contrast of least squares means ($P < 0.05$) for the total number of DEV occurrences during lactation. Effects of season, PG, litter size, and DEV were included as fixed effects, and contemporary group (herd-year-month), dam, and sire nested within breed were included in the model as random effects.

The likelihood that the occurrence of a DEV would result in a negative deviation from the predicted LFI value the following day of lactation (DEV2) was estimated using logistic regression (GLIMMIX procedure in SAS). The likelihood that a DEV2 would occur was evaluated, using the GLIMMIX procedure in SAS, as a binary trait with a model that included: fixed effects of PG, season, day of lactation, and DEV the previous day, a covariate for litter size, and random effect of contemporary group.

Results and Discussion

Reproductive performance and ADFI were reduced as the number of negative deviations increased in purebred and F1 sows as shown in Table 1. Litter weaning weight decreased with each additional negative deviation until at least 3 negative deviations occurred in which litter weaning weight remained at a constant value for litters produced by purebred and F1 sows. Wean-to-service interval remained constant when 0, 1, or 2 negative deviations occurred but when the number of negative deviations during lactation reached at least 3, wean-to-service interval began to increase. During lactation, feed intake and body reserves are the only sources of nutrients available for maintenance and milk production, and one directly affects the other. Initially, the reduction in LFI resulted in lighter litters at weaning, though after several negative deviations occurred it was likely that a sow's body reserves were mobilized to compensate for the inadequate supply of nutrients available from the sow's diet for milk production and maintenance. As body reserves were mobilized, litter weaning weights

remained constant while wean-to-service interval increased. When LFI was adequate, the sow could provide enough nutrients to her litter and maintain body reserves.

Average daily feed intake during lactation was reduced with each additional negative deviation in purebred and F1 litters. The occurrence of a single negative deviation during lactation affects intake throughout lactation and negatively impacts performance. Limiting or avoiding negative deviations increase average daily intake and improves performance.

Limiting the number of negative deviations allows sows to maximize reproductive performance. It is highly likely that a sow which had a negative deviation would have another deviation the following day. Purebred sows which had a negative deviation were 8.7 times more likely to have a DEV2 than sows that had adequate intake the previous day. A DEV2 was 39.5 times more likely to occur in F1 sows that had a negative deviation the previous day. As occurrences of negative deviations increased, performance decreased and it was more likely that multiple negative deviations would occur during lactation.

Lactation feed intake plays a significant role in litter performance and the sow's ability to remain in the breeding herd. Management of sows during lactation, especially feeding methods and feed intake, affect performance. Managing sows during lactation continues to be an essential component of a sow's success and feeding sows with the intentions of meeting predicted lactation feed intake levels should reduce the occurrence of negative deviations during lactation and maximize reproductive performance.

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Figure 1. Least squares means for daily lactation feed intake by breed in a study of lactation feed intake.

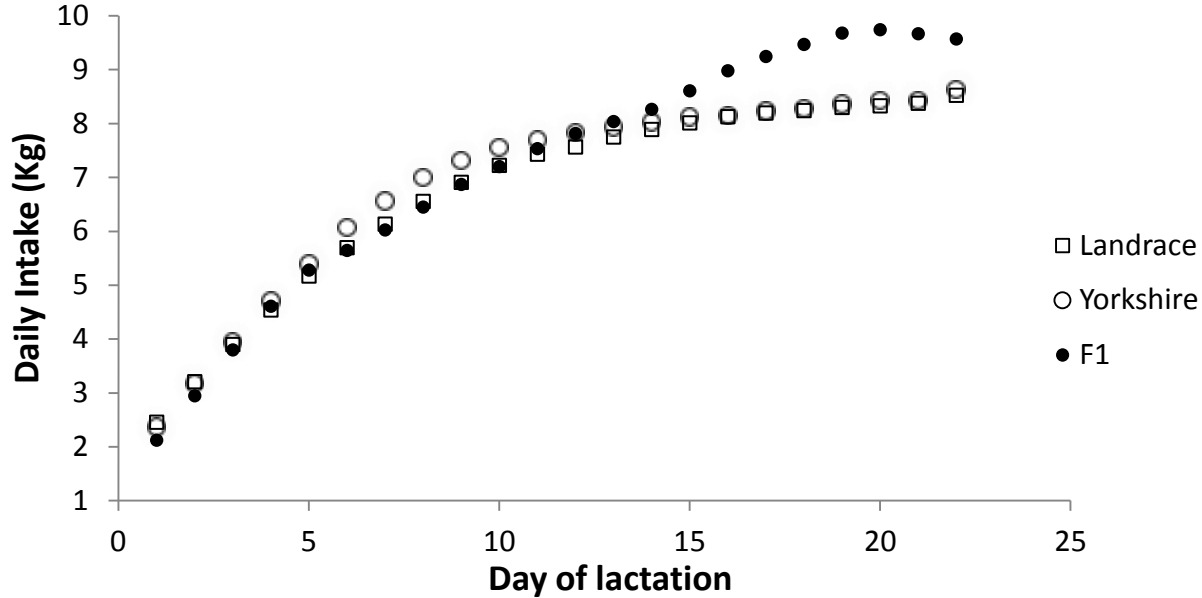


Table 1. Least squares means for reproductive performance and ADFI by number of DEV throughout a lactation in purebred and F1 sows.

Performance of purebred Landrace and Yorkshire sows			
Negative Deviations	21-day litter weaning weight (kg) ^x	Wean-to-service interval (days)	Average daily lactation feed intake (kg/day) ^z
0	83.28 ± 0.46 ^c	5.49 ± 0.05 ^{a,b}	6.73 ± 0.08 ^f
1	81.78 ± 0.53 ^b	5.45 ± 0.06 ^a	6.37 ± 0.08 ^e
2	81.16 ± 0.64 ^{a,b}	5.48 ± 0.07 ^{a,b}	6.04 ± 0.08 ^d
3	80.58 ± 0.85 ^{a,b}	5.58 ± 0.09 ^{a,b}	5.80 ± 0.09 ^c
4	79.22 ± 1.02 ^a	5.69 ± 0.12 ^b	5.44 ± 0.10 ^b
≥ 5	79.54 ± 1.03 ^a	5.63 ± 0.11 ^{a,b}	4.85 ± 0.10 ^a
Performance of F1 sows			
0	82.80 ± 0.49 ^d	5.00 ± 0.09 ^a	6.96 ± 0.06 ^e
1	81.98 ± 0.57 ^c	5.00 ± 0.09 ^a	6.43 ± 0.06 ^d
2	81.31 ± 0.64 ^{b,c}	5.05 ± 0.10 ^{a,b}	6.24 ± 0.07 ^c
3	80.78 ± 0.71 ^{a,b}	5.07 ± 0.10 ^{a,b}	6.03 ± 0.07 ^b
4	79.53 ± 0.88 ^a	5.12 ± 0.12 ^{a,b}	5.99 ± 0.08 ^{a,b}
≥ 5	79.59 ± 0.75 ^a	5.19 ± 0.11 ^b	5.53 ± 0.07 ^a

^{a-f} Least squares means within column and population with different superscripts are significantly different ($P < 0.05$).

^x 21-day litter weaning weight was adjusted for breed, parity, and to a litter size of 12, and a 21 day lactation length.

^z Average daily feed intake during entire lactation period (kg/day).