Effect of a Seven Day Stair-Step Feeding Regimen Versus Ad Libitum Feeding Throughout Lactation on Sow and Litter Performance

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Introduction

Stair-step feeding regimens, commonly implemented in Europe, are intended to reduce the incidence of periparturient hypogalactia syndrome (PHS; formerly known as mastitis metritis and agalactia, MMA) and transient drops in mid-late lactation feed intake. Swedish stair-step feeding regimens usually start the sow on a feed intake close to maintenance the day of or the day after farrowing and step up feed intake in small increments over the entire lactation length. Some American producers have adopted a modified version of this strategy and step up sow feed intake gradually during the first 3 to 4 days postpartum. Again, the intent is to step up the sow's feed intake slowly and avoid drops in feed intake later in lactation. Avoiding symptoms sometimes associated with PHS, such as feed refusal and constipation, are other reasons American producers sometimes restrict sow feed intake early in lactation.

Feed restriction during early lactation reduces total lactation feed intake (Moser et al., 1987; Stahly et al., 1979), increases mobilization of sow body fat reserves (Neil, 1996), and extends the wean to estrus interval (King and Dunkin, 1986). Restriction of feed intake during lactation reduces levels of insulin, glucose and IGF-1 in sows; decreased levels of these compounds are hypothesized to be directly involved in the reduction in ovarian activity and LH pulse frequency (Tokach et al., 1992).

The objectives of this study were to 1) assess the impact of two lactation feeding regimens on sow feed intake, body weight loss, backfat loss, litter weight gain and preweaning mortality. We also wanted to 2) relate the effects of these feeding strategies to sow energy balance through the measurement of circulating metabolite levels.

Materials and Methods

Sixty lactating sows of two genotypes (A=1/2 Landrace, 1/4 Large White, 1/4 Duroc, n=21; B=1/2 Yorkshire, 1/2 Landrace, n=39), nursing litters of 9 pigs or more, were utilized. Sows were randomly assigned to receive either ad-libitum access to feed (AL, n= 29), or were fed in a stair-step regimen (SS, n=31) from day 1 to day 7 of lactation (2, 4, 6, 8, 10, 12, 14 lb/day) followed by ad libitum feeding for the remainder of lactation. Sows were fed a 16.0% crude protein, 0.80% lysine, corn-soybean meal based lactation diet beginning the day following parturition (day 1 in our study). Sows were fed their assigned feed allowance with a set of graded feed scoops so that the amount fed could be recorded. Because sows were fed twice daily at 6:30 a.m. and 2:30 p.m., stair-step sows received half of their feed in the morning and half in the afternoon. Likewise, during ad libitum feeding sows were fed twice daily, and enough feed was added to ensure there would be some feed left in the feeder at the next feeding. Sow feed intake (feed disappearance) was measured daily at 6:00 a.m. for the duration of lactation.

Sow body weight (BW), 10th rib backfat depth (BF), and litter weight (LW) were measured on days 2, 7, and 21, and at weaning. Preprandial sow blood samples were drawn via jugular venipuncture between 6:00 and 7:00 a.m. on day 7, day 21 and at weaning for analysis of plasma urea nitrogen (PUN), creatinine and non-esterified fatty acid (NEFA) levels.

Results and Discussion

Sow feed intake was lower for SS-fed sows during the first week of lactation (7.4 vs. 11.2 lb, P<.01) because of the imposed feed restriction (Table 1). However, SS-fed sows did not have greater feed intakes than AL-fed sows during week 2 or week 3. There was no evidence to support the hypothesis that sows fed AL early in lactation would have decreased feed intakes later in lactation (Figure 1). The imposed restriction of the SS treatment resulted in SS-fed sows consuming significantly less feed than AL-fed sows by the end of 3 weeks (198 vs. 234 lb, P<.02).

Litter size was approximately 0.5 pig greater for AL sows at day 2 of lactation (10.1 vs. 9.6), but both the AL and SS treatments lost proportional numbers of pigs during lactation (0.75 vs. 0.41 pigs, 7.4 vs. 4.3% preweaning mortality). Thus, the SS regimen did not increase preweaning mortality (PWM). Litter size on day 2 was used as a covariate to adjust for the initial difference in litter size. Litter weight at day 2 was not different between treatments, but litter weight gain (LWG) was greater for AL sows during the feed restriction on days 2 to 7 (20.8 vs. 17.1 lb, P<.06). Litter weight gain from days 7 to 21 was not significantly greater for AL-fed sows (71.5 vs.68.1 lb), but litter weight gain from day 2 to weaning was approximately 14 lb greater for AL-fed sows than for SS-fed sows (100.9 vs. 87.2 lb).

Sows from both treatments had similar BW at day 2 (approximately 500 lb), and BW loss was low (0.3 lb) from days 2 to 7. Sow BW loss from days 7 to 21 was greater for AL-fed sows (22.6 vs. 8.8 lb, P<.11), and was numerically greater from day 2 to weaning (24.2 vs. 13.0 lb). With respect to the feed restriction of the SS treatment, this is somewhat the opposite of what was expected. However, AL-fed sows' litters gained more weight from days 7 to 21 and from day 2 to weaning, and this may explain their greater weight loss. AL-fed sows may have been using more energy from body reserves to produce milk for litter growth than SS-fed sows, because sow feed intakes were similar from day 7 to weaning (Figure 1). Sow BF at day 2 was approximately 1.06 inches for both treatments; BF loss was similar from days 2 to 7 and day 2 to weaning, but was slightly greater from days 7 to 21 for AL-fed sows (0.98 vs. 0.71 in). This coincides with the period when AL-fed sows' litters were gaining more weight than litters of SS-fed sows. Weaning to estrus interval (WEI) data could only be obtained on one of the sow genotypes (A). The WEI for genotype A was slightly longer for SS-fed sows (5.4 vs.5.1 days), and there were 2 anestrus sows from the SS treatment and none from the AL treatment for this genotype. Mean WEI was relatively short, and a short WEI may be a characteristic of this genotype or may be a result of good management.

Plasma urea nitrogen levels were slightly higher for SS-fed sows, but the difference was not significant. High levels of PUN might indicate muscle catabolism or inefficient use of amino acids from dietary sources. Plasma creatinine levels tended to be higher in SS-fed sows at day 7 (1.98 vs. 1.83 mg/dL, P<.07) and at day 21 (1.97 vs. 1.84 mg/dL, P<.09). Creatinine is a by product of creatine metabolism. Creatine made by the liver, kidneys and pancreas is transported to muscle where it is phosphorylated to serve as a source of energy, much like ATP. A relatively constant amount of creatine is converted into creatinine daily in muscle and is then excreted. However, during periods of muscle catabolism (breakdown), circulating levels of creatinine are elevated. Thus, elevated levels of creatinine in SS-fed sows may indicate greater levels of muscle catabolism than in AL-fed sows. Serum NEFA levels were not greater for SS sows at day 7 (312 vs. 342 umol/L), but were elevated at day 21 (405 vs. 256 umol/L, P<.01). Non-esterified fatty acid (or free fatty acid) levels are a good indicator of fat breakdown (lipolysis), and elevated levels of NEFA in SS sows suggest increased mobilization of fat reserves. Thus, both elevated creatinine and NEFA levels indicated that SS-fed sows had greater body reserve mobilization due to the early lactation feed restriction.

Applications

Restriction of feed intake during the first week of lactation did not significantly increase sow body weight or backfat loss. However, increased mobilization of sow body reserves (fat and muscle) was suggested by increased NEFA and creatinine levels in the SS fed sows. The SS feeding regimen did not significantly affect preweaning mortality. However, LWG was reduced from days 2 to 7 and was somewhat lower overall for SS-fed sows. The slightly extended WEI and greater number of anestrus sows in the SS treatment might indicate that subsequent reproductive performance was compromised by feed restriction during early lactation.

Thus, a short SS feeding regimen during the first week of lactation offered no improvement in subsequent lactation feed intake and resulted in a reduction in LWG. This short SS feeding regimen did not produce the intended benefits that longer, more gradual SS feeding strategies were designed for. The number of sows showing decreasing feed intakes or symptoms sometimes associated with PHS was not different between treatments. There were no benefits of restriction of feed intake during early lactation found in this study. Therefore, based on these data we would recommend introduction of ad libitum feeding the day after farrowing as long as no problems with feed refusal, constipation or other PHS symptoms were noted in the sow herd.

References

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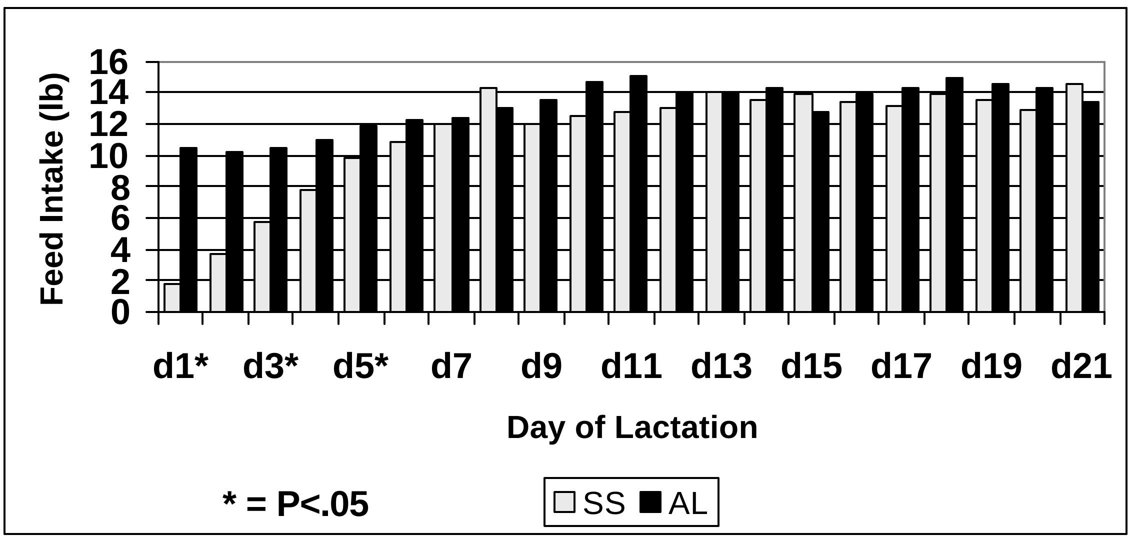

Figure 1. Daily feed intakes of SS and AL fed sows.

Table 1. Effect of a short stair-step feeding regimen versus ad libitum feeding on sow feed intake, sow body reserve mobilization and litter growth performance.

		Stair-Step	Ad Libitum	ANOVA
No. of Sows		31	29	
Lactation Length (days)		22.0 ± 1.5	24.1 ± 1.5	ns
ADFI (lb), Week 1		7.39 ± 0.42	11.22 ± 0.42	P<.01
ADFI (lb), Week 2		12.81 ± 0.84	14.16 ± 0.79	ns
ADFI (lb), Week 3		13.58 ±0.84	14.02 ±0.79	ns
Total FI (lb), 3 Week		198.2 ±10.5	234.2 ± 10.5	P<.02
Litter Size, d2		9.6 ± 0.3	10.1 ± 0.3	ns
Litter Size, Wean		9.2 ± 0.3	9.4 ± 0.3	ns
PWM		0.4 ± 0.2	0.8 ± 0.2	ns
LW (lb)	d2	38.3 ± 1.5	39.9 ± 1.5	ns
LWG (lb)	d2-d7	17.1 ± 1.4	20.8 ± 1.4	P<.06
	d7-d21	68.1 ± 5.0	71.5 ± 4.7	ns
	d2-Wean	87.2 ± 9.5	100.9 ± 9.1	ns
BW (lb)	d2	505.7 ± 11.9	506.4 ± 11.8	ns
BW Loss (lb)	d2-d7	0.1 ± 3.6	0.6 ± 3.7	ns
	d7-d21	8.8 ± 6.2	22.6 ± 6.6	P<.11
	d2-Wean	13.0 ± 4.1	24.2 ± 4.8	ns
BF Depth (in)	d2	1.08 ± 0.04	1.07 ± 0.04	ns
BF Loss (in)	d2-d7	0.06 ± 0.02	0.04 ± 0.02	ns
	d7-d21	0.07 ± 0.02	0.10 ± 0.02	ns
	d2-Wean	0.12 ± 0.03	0.13 ± 0.03	ns
WEI (days)		5.4 ± 0.4	5.1 ± 0.4	ns
PUN (mg/dL)	d7	17.24 ± 0.74	16.28 ± 0.70	ns
	d21	18.44 ± 0.71	16.91 ± 0.68	ns
Creatinine (mg/dL)	d7	1.98 ± 0.06	1.83 ± 0.05	P<.07
	d21	1.97 ± 0.05	1.84 ± 0.05	P<.09
NEFA (umol/L)	d7	311.8 ± 41.3	341.9 ± 39.4	ns
	d21	404.5 ± 39.5	256.1 ± 37.6	P<.01