Effect of split-weaning interval on return to estrus and sow fertility

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Summary

Objective: To determine the effect on timing of return to estrus and subsequent fertility of primiparous and multiparous sows when litter size suckled is reduced to five piglets (split weaning) 5, 6, or 7 days before full weaning.

Methods: Primiparous (n=181) and multiparous (n=759) sows of Large White and Landrace breeding on a commercial swine farm were assigned at the time of parturition to be either split weaned (n=628) or to serve as controls (n=312). Sows were split weaned by removing the heaviest piglets at 21 days of lactation, leaving five to seven piglets with the sow until full weaning 5, 6, or 7 days later. Control litters were weaned at 22±4 days of lactation. Sows were bred at the first observed estrus after full weaning.

Results: The mean wean-to-estrus interval (WEI) was longer ($P<.01$) for primiparous than multiparous sows. The WEI was shorter (P .05) for so ws split weaned 6 or 7 days before full weaning than for control sows, but was not different for sows split weaned 5 days before full weaning. In both parity groups, split-weaned sows tended to return to estrus 1 day earlier than control sows. The percentage of sows bred by day 5 after weaning was greater when sows were split weaned 6 or 7 days before full weaning ($P<.06$ for primiparous and $P<.02$ for multiparous sows) than for control sows, but was not different for sows split weaned 5 days before full weaning. Farrowing rate to first service and subsequent total born litter size were not affected by treatment.

Implications: On this farm, with the lactation length employed, split weaning of litters for up to 7 days before full weaning slightly advanced the onset of the post-weaning estrus. For other farms, it is possible that where a high proportion of sows are bred 6 days or more after weaning (presumptive infertile period), the practice of split-weaning may increase the proportion of sows bred by 5 days after weaning, and so potentially increase herd fertility. However, the efficacy of split weaning should be evaluated for individual farms.

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The interval from weaning to estrus (WEI) is a major contributor to sow nonproductive days; therefore reducing both the length and variance of WEI should be a management objective, especially in primiparous sows. This objective may be achieved by injecting sows with exogenous gonadotropins.[1] However, a management approach that minimizes the need for exogenous gonadotrophins is required. Split weaning, the weaning of the heavier pigs in a litter a few days before full-weaning, is a nonpharmacological approach to the management of the WEI.

There is considerable controversy in the literature as to the efficacy of split weaning for improving sow reproductive performance, with authors noting either improved performance[2,3] or no effect on performance.[4,5] Similarly, the influence of the length of the split-weaning interval is contentious, with suggested effective intervals of 2 to 3 days,[2,6] 5 days,[7] or 7 days.[3]

Previous authors have focused on the effects that split weaning has on the mean number of days in the WEI, but an effect on the distribution of the WEI may be more important. It is recognized that sows bred between day 6 and about day 12 after weaning are at a higher risk of reduced farrowing rate and reduced subsequent litter size.[8,9] Therefore, a change in the distribution of the WEI might have a significant effect on sow fertility without having a significant effect on the mean WEI.

The objective of the present study was to determine the effect of different split-weaning intervals on the timing of return to estrus and fertility of sows. A large commercial facility was involved in order to generate sufficient data to examine the effect of treatment on the distribution of the WEI.

Material and methods

During 18 consecutive months, a total of 181 primiparous and 759 multiparous sows of Large White and Landrace breeding on a large commercial swine farm near Brescia (Italy) were assigned at the time of parturition to be either split weaned (SW; n=628) or to act as controls (n=306). Piglets were cross fostered within 48 hours of birth as required to equalize litter size, which, as far as possible, was standardized at nine to ten piglets. In split weaned litters, the heaviest piglets were removed on day 21 of lactation, in order to leave five to seven piglets with the sow until full weaning. The proportion of the original litter that remained with the sow did not differ among treatment groups: 39.6%–41.8% of the piglets remained with the sow. The targeted split-weaning interval was 6 days (SW6; n=221) or 7 days (SW7; n=344). However, some multiparous sows were split weaned for only 5 days, and these were included as a third treatment group (SW5; n=63). The entire litters of control sows were weaned at 22 ± 4 days of lactation. Piglet weights were not recorded.

During lactation, sows were housed in farrowing crates and fed 6 kg per day of a commercial lactating sow diet formulated

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to contain 14 MJ DE per kg and 18.8% crude protein. After weaning, sows were fed 3.5 kg per day of the lactation diet until breeding. During gestation, they received 2.3 kg per day of a gestation ration formulated to contain 12.5 MJ DE per kg and 15% crude protein.

At weaning, sows were transferred to pens adjacent to mature boars and checked twice a day for estrus onset with direct boar contact. All sows were bred by artificial insemination at the detection of estrus and again 24 hours later, using commercial semen with 3×10^9 spermatozoa per dose. Three weeks after insemination, sows were rehoused in groups of four or five.

Statistical analysis

Analyses were performed using the GLM procedures of SAS® (Statistical Analysis System Institute, Inc.; Cary, North Carolina) to derive least-squares means and standard errors. Classes included in the model were parity and split-weaning interval, and the dependant variables were WEI and subsequent litter size. The month of weaning was found to be significant and so was included as a covariate. Full lactation length, full litter size suckled, numbers of pigs removed, number of pigs remaining, and the proportion of the litter remaining with the sow had no significant effects on WEI or subsequent litter size, so were not included as covariates. Only sows detected as estrous by 18 days after weaning were included in the analyses, in order to minimize the possibility of including sows bred at their second estrus after weaning. All other sows were designated as anestrus. A Shapiro-Wilk test for skewness of the raw and log-transformed data indicated that the distributions of WEI were positively skewed, but the magnitude of the skewness was not different among treatments. Homogeneity of variance in the WEI was examined using Bartlett's test. Treatment effects on percentage of sows bred at <4 days, 4 days, and 5 days, and farrowing rates, were compared using Fisher's exact test.

Results

Of the 940 sows, 26 failed to exhibit estrus by 18 days after weaning, with no significant association with treatment. There was no significant effect (P=.10) of treatment on the variance of the WEI. The mean WEI was greater (P=.02) for parity-one sows (6.1 ±0.23 days) than for multiparous sows (4.9 ±0.10 days). When all sows were considered, the WEI in sows split weaned for 6 days ($P < .03$) and for 7 days ($P < .06$) were shorter than in control sows. For primiparous sows, the WEI was numerically shorter ($P = .15$) in sows split weaned for 6 days (SW6) and significantly shorter ($P = .04$) in sows split weaned for 7 days (SW7), compared to their control sows. For multiparous sows, the WEI was shorter ($P = .01$) in sows split weaned for 6 days compared to their control sows, but was unaffected ($P = .27$) by other treatments (Table 1).

The distribution of WEI appeared to be affected by split weaning. Compared to multiparous control sows, a greater proportion of multiparous SW5 sows ($P < .01$) and multiparous SW6 sows ($P < .04$) were detected in estrus <4 days after weaning. No effect was evident for multiparous SW7 sows or for any primiparous treatment group (Table 1). Similarly, compared to control sows and within parity, the proportion of sows bred by 5 days after weaning was higher for SW6 primiparous ($P < .06$) and multiparous ($P < .01$) sows, and SW7 primiparous ($P < .03$) and multiparous sows ($P < .02$).

Split weaning tended to increase farrowing rate for primiparous SW6 sows (P<.1) and SW7 sows ($P < .04$) compared to their controls, but no effect was evident in the multiparous sows (Table 1). Subsequent totalborn litter size tended to be higher ($P < .09$) for multiparous sows (10.5 ±0.1) compared to primiparous sows (9.9 ±0.3). However, split weaning had no effect on subsequent totalborn litter size (Table 1).

Discussion

The control sows had a shorter lactation length than the split-weaned sows. However, the average duration of lactation (>21 days) and the magnitude of the differences in duration of lactation between treatment groups were such that a significant effect on the WEI is unlikely. This was confirmed by the lack of a significant effect of full lactation length in the statistical model. Other workers have also found split weaning to have a relatively small effect on the mean WEI and no effect on litter size. However, of potentially greater importance in this study is the pattern of return to estrus:

Table 1. Effect of split weaning for 5 (SW5), 6 (SW6) or 7 (SW7) days, or not split weaning (control), on the incidence of anestrus, wean-to-estrus interval (WEI; ls mean ± se), cumulative percentage of sows exhibiting estrus 5 days, 4 days, or < 4 days after weaning; farrowing rate; and subsequent total born litter size (ls mean ± se) for primiparous and multiparous sows.

	Anestrous sows	Weaning-to-estrus interval, days	Cumulative percent of sows showing estrus after weaning < 4 days	Day 4	Day 5	Farrowing rate	Subsequent totalborn litter size
Primiparous sows							
SW6 (n=43)	11.6%	5.2±0.4	0	34.2%	78.9%	89.5%	10.0±0.5
SW7 (n=65)	3.1%	5.0±0.3[a]	6.3%	41.3%	79.4%[a]	90.5%[a]	10.1±0.4
control (n=73)*	1.4%	6.0±0.3	1.4%	13.9%	62.5%	77.8%	10.2±0.4
Multiparous sows							
SW5 (n=63)	6.3%	4.9±0.3	13.6%[c]	35.6%	74.6%	72.9%	10.4±0.4
SW6 (n=178)	0.6%	4.6±0.2[a]	6.8%[a]	47.5%	89.3%[c]	81.9%	10.4±0.3
SW7 (n=279)	2.1%	5.0±0.2	3.3%	46.2%	82.8%[b]	87.5%	10.4±0.2
control (n=239)*	2.9%	5.4±0.2	2.6%	25.9%	74.6%	81.5%	10.8±0.3

* Control sows were weaned at 22±4 days of lactation

Treatment means followed by a letter differ from controls: a, $P < .05$; b, $P < .02$; c, $P < .01$

with split weaning, more sows were bred by 5 days after weaning. Since it is known that reproductive performance may be depressed in sows bred between day 6 and about day 12 after weaning,[8,9] the effect of split weaning could prove beneficial for those herds experiencing reduced performance associated with prolonged wean-to-estrus intervals. Performance measures of SW6 and SW7 sows did not differ.

It was noted that in the SW5 sows, neither the percentage bred by 5 days after full weaning nor the farrowing rate were different from the control sows. However, the percentage of SW5 sows bred <4 days after weaning was higher than the controls. Therefore, it is possible that a proportion of the SW5 sows had an unobserved estrus during late lactation or very soon after weaning. It is possible that a higher percentage of SW5 sows were cyclic than was indicated by the percentage bred by 5 days after weaning, but without circulating progesterone determinations, this is speculative. Further, the higher proportion of sows bred by <4 days after weaning may explain the lack of effect of SW5 on farrowing rate, since sows bred <4 days after weaning tend to have poor reproductive performance (Aherne, 1999; unpublished data).[9]

If SW5 sows were returning to estrus very early, it would support the conclusion of Britt[10] that the optimal split-weaning interval may be as short as 3 days. The rationale for this is that the reduced suckling intensity associated with split-weaning acutely elevates circulating gonadotropin concentrations and permits increased follicular development. Indeed, an increase in the number of 4-mm ovarian follicles at weaning has been observed in sows subjected to a 3-day split wean (Zak and Kirkwood, 1999; unpublished data). Gonadotropin concentrations are reported to revert to basal levels 2–3 days after split weaning,[11] but in the present study, improved performance was associated with 6- or 7-day split weaning. During the split-weaning interval, the milk intake of the remaining pigs increases, but the overall milk yield of the sow decreases. If sow feed intake is maintained while milk yield decreases, the metabolic state of the sow will improve. This was not confirmed by the present study because sow feed intakes and piglet weights were not recorded. However, we suggest that split weaning, in addition to having endocrine effects, may also enhance sow performance by reducing the metabolic demands on the sow in late lactation, resulting in an improved metabolic state at weaning. This may explain why the practice of split weaning has been associated with variable results: if the metabolic status of the sow is not limiting fertility, no effect of split weaning will be evident.

Implications

- For this farm and with the lactation lengths employed, the practice of split weaning litters 6 or 7 days before full-weaning modified the pattern of return to estrus after weaning.
- On farms where a high proportion of sows are bred 6 days or more after weaning (presumptive infertile period), the practice of split weaning may increase the proportion of sows bred by 5 days after weaning and thus may potentially increase herd fertility.
- The efficacy of split weaning should be evaluated for individual farms.

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