INTERVAL TO ESTRUS IN SOWS AND PERFORMANCE OF PIGS AFTER ALTERATION OF LITTER SIZE DURING LATE LACTATION

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Summary

The effects of altering litter size during the 5 days before weaning on interval to estrus of sows and postweaning performance of pigs were examined. Litters averaged 8.3 ± .7 pigs from parturition until 5 days before weaning. Litters were then adjusted so that sows (five per group) nursed small- (three pigs), average- (eight pigs) or large-sized (13 to 14 pigs) litters during the last 5 days of lactation. Weaning occurred 27.4 ± .7 days postpartum. Interval from weaning to estrus (days) and duration of estrus (hours) for sows that weaned small-, average- and large-sized litters averaged 1.1 ± .4 and 38 ± 4, 4.1 ± .4 and 60 ± 4, and 4.0 ± .4 and 61 ± 4, respectively. Interval to estrus and to ovulation and duration of estrus were decreased (P<.01) in sows that nursed only three pigs before weaning. Pigs weaned from foster sows weighed less (P<.05) at weaning than pigs weaned from their dams. However, by 3 weeks after weaning, body weights were similar. Body weight at weaning and at 3 weeks postweaning and average daily gains during the 3 weeks after weaning were similar for pigs weaned from small-, average- and large-sized litters. Reducing the litter size before weaning resulted in earlier postweaning estrus and ovulation and had no adverse effects on the performance of weanling pigs.

(Key Words: Estrus, Postweaning, Sows, Litter Size, Progesterone, Nursing.)

Introduction

Altering the nursing pattern of pigs may be effective in either inducing estrus in the dam before weaning or decreasing the interval to remating after weaning. Grouping lactating sows together with their pigs at 2 to 3 weeks postpartum, either in the presence (Rowlinson et al., 1975; Rowlinson and Bryant, 1976; Petchey and Jolly, 1979) or in the absence (Petherick et al., 1977) of boars, resulted in lactational estrus and/or fertile matings. Smith (1961) observed that sows separated from their pigs for 12 hr daily returned to estrus within 1 to 2 weeks, even though lactation continued. Walker and England (1977) reported that 27 of 28 sows mated during the third through sixth weeks of lactation when separated from their pigs for 6 hr daily and exposed to boars. Estrus was observed during lactation in sows whose pigs were allowed only four, six or eight 30-min nursing periods daily during the last 7 to 10 days of lactation (Thompson and Jensen, 1979; Thompson et al., 1980). Britt and Levis (1980) demonstrated that sows suckled during alternate 12-hr periods for 48 hr before weaning had shorter-intervals to estrus after weaning than did controls.

The study reported herein investigated the possibility of altering estrus in sows by disrupting normal nursing patterns during the last week of lactation, and evaluated postweaning performance of pigs weaned from these sows.

Experimental Procedure

Fifteen sows of mixed breeding farrowed over a 10-day period in February and March 1980, and their litters were standardized to 7 to 11 pigs within 48 hr after parturition. All sows were confined to farrowing crates during lactation and were fed twice daily 2.7 kg of

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a corn-soybean diet (14% protein) balanced for protein and energy plus supplemental vitamins, minerals and salt to meet NRC (1979) requirements. Panels between three adjacent crates were removed after 2 weeks of lactation, allowing pigs the opportunity to nurse any of the three sows until 5 days before weaning, when treatments were imposed. Treatments consisted of altering litter size to small (three pigs), average (eight pigs) and large (13 to 14 pigs) during the last 5 days of lactation (lactations averaged 27.4 ± .7 days). Five sows were assigned to each treatment according to body weight, parity and pretreatment litter size. Pigs were allocated so that each sow received a random proportion of her own pig(s) and pigs from the two other sows to which her pigs had been exposed since 2 weeks of age. Blood was collected on the sixth day before weaning, on the day of weaning and on days 3, 6 and 9 after weaning for confirmation of ovulation by examination of changes in radioimmunoassayable progesterone (Stevenson et al., 1981). In addition, sows were checked for estrus twice daily with intact boars.

Pigs were weighed individually before litter sizes were altered, at weaning and weekly thereafter for 3 weeks. Fresh creep feed and water were provided ad libitum after the pigs reached 2 weeks of age. Creep feed was composed of grain and plant protein products (18% protein), sucrose, cane molasses, roughage products and preserved animal fat, and was supplemented with vitamins, minerals and salt. After weaning, 120 pigs were moved to a completely enclosed nursery (23 to 24 C) with slatted concrete floors, nipple waterers, self-feeders and under-slat ventilation. Pigs (five per pen) were randomly assigned to five postweaning diets. Diets consisted of corn and soybean meal supplemented with vitamins, minerals and salt (control) or the control plus two levels of either a milk product or dehydrated whey calculated to provide 20% protein in all diets. Average daily gain (ADG) was determined for 3 weeks after weaning.

Data were analyzed by analysis of variance (days to estrus, duration of estrus) or by split-plot analysis of variance (progesterone) where appropriate (Gill, 1978). The effect of treatment and fostering (removal of pigs from their dams) on body weight (BW) and postweaning ADG were analyzed according to the following model, chosen to eliminate pen and diet effects after weaning:

\[ Y_{ijklm} = \mu + T_i + F_j + D_k + P_{(k)} + IBW_m + E_{ijklmn} \]

where

- \( Y_{ijklm} \) = BW or ADG of the nth pig during each period examined,
- \( \mu \) = overall mean,
- \( T_i \) = effect of the ith treatment (three, eight or 13 to 14 pigs),
- \( F_j \) = fostering effect (fostered versus nonfostered),
- \( D_k \) = effect of the kth postweaning diet,
- \( P_{(k)} \) = effect of the ith pen within the kth diet,
- \( IBW_m \) = initial BW and
- \( E_{ijklmn} \) = random error associated with the nth pig.

Results

Reducing litter size to three pigs 5 days before weaning resulted in earlier (P<.01) postweaning estrus than was observed for sows weaning average- or large-sized litters (table 1). However, increasing litter size to 13 to 14 pigs did not prolong the interval to onset of estrus beyond that noted for sows weaning eight pigs. Reducing the number of nursing pigs to three resulted in inadequate suckling inhibition of cyclic ovarian activity, as four of five sows were in estrus within 6 days (by day 1 after weaning). Presumably, these sows would have been in estrus even if weaning had not occurred, because two of the five were in estrus at weaning.

Duration of estrus was shorter (P<.01) for sows weaning small litters than for sows in the two other treatment groups. Since duration of and interval to estrus were similar for the latter, progesterone data were combined. Ovulation occurred earlier in sows weaning small litters, because serum progesterone concentrations were higher (P<.01) on days 3 and 6 after weaning than in the other sows (figure 1). Before litter size adjustments, litter size averaged 8.3 ± .7 pigs per sow and pigs averaged 22.4 ± .7 days of age. Pig mortality was 3%
TABLE 1. INTERVAL TO AND DURATION OF POSTWEANING ESTRUS IN SOWS AND PERFORMANCE OF PIGS AFTER ALTERATION OF LITTER SIZE DURING LATE LACTATION

<table>
<thead>
<tr>
<th>Item</th>
<th>Litter size&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small</td>
</tr>
<tr>
<td>No. of sows</td>
<td>5</td>
</tr>
<tr>
<td>Days to estrus</td>
<td>1.1 ± .4&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Duration of estrus, hr</td>
<td>37.5 ± 4&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>No. of pigs</td>
<td>15</td>
</tr>
<tr>
<td>Pig body weight at weaning&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.91</td>
</tr>
<tr>
<td>Pig body weight constants</td>
<td>.16</td>
</tr>
<tr>
<td>at 3 weeks postweaning&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Litter size altered to small (three pigs), average (eight pigs) or large (13 to 14 pigs) at 5 days before weaning. Values are least-squares means ± SE.

<sup>b</sup>Body weight (kilograms) was adjusted for initial weight before litter size adjustment.

<sup>c</sup>Least-squares constants for body weight (kilograms) were adjusted for initial weight before litter size adjustment and are expressed as deviations from body weight of pigs weaned in average-sized litters.

<sup>d</sup>One sow ovulated during lactation.

<sup>e</sup>Means in the same row with different superscripts differ (P<.01).

Overall and did not differ between treatment groups after weaning. Pigs weaned in different-sized litters had similar weights at weaning and at 3 weeks after weaning (table 1). Over all treatment groups, fostered pigs (6.7 ± .07 kg) weighed less (P<.01) than nonfostered pigs (7.0 ± .09 kg) at weaning, but BW was similar at 3 weeks after weaning. ADG of pigs weaned from small and large litters were similar to those of pigs weaned from averaged-sized litters during the 3 weeks after weaning. Likewise, ADG of pigs fostered to other sows during treatment equaled ADG of nonfostered pigs after weaning. Overall, ADG was .30 ± .01 kg/pig during the postweaning period.

**Discussion**

These data provide evidence that the onset of cyclic ovarian activity after weaning can be hastened by a reduction in litter size before weaning. Although reducing the number of pigs in a litter to three resulted in shorter intervals to estrus after weaning, increasing litter size did not delay the onset of estrus (table 1). This suggests that there may be a threshold of sucking intensity (number of nursing pigs) that must be maintained to inhibit initiation of estrous cycles during lactation in sows. Parvizi et al. (1976) observed that more than one nursing pig was necessary to inhibit estrous cycles during lactation in miniature sows.

The five sows that weaned small litters were first detected in estrus on days 0, 0, 1, 1 and 3 after weaning. The first four sows (multiparous) had litters of 8, 10, 8 and 11 pigs before treatment, while the fifth (primiparous) was nursing only four pigs before treatment because of death losses in her litter. It appears that the reduction in the number of nursing pigs must be quite dramatic to hasten cyclic ovarian function. However, younger or first litter sows under normal weaning and management sys-

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**Figure 1.** Pre- and postweaning serum progesterone concentrations in sows that weaned three (open bars) or eight to 14 (stippled bars) pigs. Values are means plus positive-halves of SE.
tems have shown more prolonged intervals to estrus after weaning than have older or multiparous sows (Radev et al., 1976; Hurtgen et al., 1980).

The reasons for shortened estrus in sows that weaned small litters are not clear. Duration of estrus ranged from 28 to 52 hr and was shorter than that observed for other sows (table 1). Possibly, estrogen barely surpassed the threshold for estrus and was dampened by nursing.

Reduction of the number of nursing pigs apparently stimulated the onset of estrus in a manner similar to that observed in other studies. Smith (1961) reported that 12, but not 10 hr daily separation beginning 3 to 4 weeks postpartum, was sufficient to induce estrus during lactation in sows. He also observed that interval to estrus after the initial separation was 1 week shorter among second litter sows than among first litter sows. Sows subjected to alternate 12-hr periods of suckling and nonsuckling for 48 hr before weaning at 3 weeks postpartum had shorter intervals to estrus after weaning than did control sows (Britt and Levis, 1980). Perhaps the duration of nonsuckling periods is as important as the number of nonsuckling periods necessary to initiate cyclic ovarian function during lactation or to induce earlier estrus in sows after weaning. However, separation of sow and litter for 6 hr daily beginning 3 weeks postpartum was sufficient to induce estrus within 10 days in 81% of the sows that were exposed to boars during separation from litters (Walker and England, 1977). Variation in responses to altered lactational management of sows appears to be related to breed, boar exposure, duration of suckling, number of days postpartum and probably other environmental factors.

In British management systems, grouping sows together with their pigs in the presence or absence of boars is a practice that has been used successfully to induce lactational estrus and fertile matings (Rowlinson et al., 1975; Rowlinson and Bryant, 1976; Petherick et al., 1977; Petchey and Jolly, 1979) even when suckling behavior of pigs has remained apparently unchanged after grouping (Rowlinson et al., 1977). Similar treatments given in the United States under different conditions of management and environment and with different breeding stock have not induced estrus during lactation (Guthrie et al., 1978).

Postweaning performance of pigs was not adversely affected by altered litter size. It is not clear why improved postweaning weight gains were observed in other studies in which pigs were subjected to limited nursing periods during late lactation (Walker and England, 1977; Thompson and Jensen, 1979; Thompson et al., 1980). In studies in which pigs were provided with creep starter diets of differing complexity before weaning at 3 or 5 weeks, postweaning performance did not differ from that of control pigs that received no creep (Okai et al., 1976). However, a two- to threefold increase in preweaning creep consumption was observed among pigs allowed to nurse for 30 min four, six or eight times daily during the last 7 to 10 days of lactation. Although pigs with increased preweaning intake had higher postweaning ADG than pigs allowed to suckle ad libitum, total gains before and after weaning were similar or less (Thompson and Jensen, 1979; Thompson et al., 1980). Pigs weaned from large litters in the present study consumed twice as much creep before weaning as pigs weaned from average-sized litters. However, pigs from large litters failed to make higher ADG after weaning, even though their daily gains averaged 20 to 50 g more/pig than those of pigs from average-sized litters.

There are several ways in which reduction of litter size before weaning could be used in contemporary management systems. Weaning of all large pigs at 3 weeks and redistribution of the remaining small pigs among several sows to form litters of two to three pigs would allow some pigs to be weaned early and some to be weaned 5 to 7 days later. Small pigs allowed to nurse for 5 to 7 extra days would receive more milk because of less competition, and this might improve their survival and postweaning performance. Sows weaning small litters would probably be ready to be rebred at or near weaning, which would nearly coincide with the normal onset of estrus in the sows whose pigs were weaned 5 to 7 days previously. This and similar management systems need to be evaluated further and tested in more detail for their repeatability and efficacy in improving sow and pig performance.

Literature Cited


