Effects of intermittent suckling and creep feed intake on pig performance from birth to slaughter

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ABSTRACT: An experiment was conducted to determine if the improved creep feed intake observed during intermittent suckling (IS) is important for postweaning performance. Therefore, creep feed intake of litters was assessed, and within litters, eaters and noneaters were distinguished using chromic oxide as an indigestible marker. Batches of sows were suckled intermittently (IS, 7 batches; n = 31) or continuously (control, 7 batches; n = 31). In the IS group, litters were separated from the sow for a period of 12 h/d (0930 to 2130), beginning 11 d before weaning. Litters were weaned at 4 wk of age. Litters had free access to creep feed from 1 wk of age onward. Five days after weaning, the piglets were moved as a litter to weanling pens. At 8 wk of age, 2 barrows and 2 gilts were randomly chosen from each litter and moved to a finishing facility. Feed intake was improved by IS during the last 11 d of lactation (IS, 284 ± 27 vs. control, 83 ± 28 g/piglet; P < 0.001) and after weaning during the first (IS, 201 ± 24 vs. control, 157 ± 25 g/piglet−1 d−1; P < 0.05) and second (IS, 667 ± 33 vs. control, 570 ± 35 g/piglet−1 d−1; P < 0.05) wk. Thereafter, no differences were found to slaughter. Weaning BW was lower in IS litters (IS, 7.1 ± 0.01 vs. control, 8.1 ± 0.01 kg/piglet; P < 0.05), but 7 d after weaning BW was similar (IS, 8.5 ± 0.2 vs. control, 8.7 ± 0.2 kg/piglet; P = 0.18), and no differences were found to slaughter. The percentage of eaters within a litter was not increased by IS during lactation (IS, 23 ± 4.5% vs. control, 19 ± 4.1%; P = 0.15). Weaning BW did not differ between eaters and noneaters (eater, 7.7 ± 0.1 vs. noneater, 7.5 ± 0.08 kg/piglet; P = 0.63). From 1 until 4 wk after weaning, piglets that were eaters during lactation had heavier BW than noneaters (eater, 20.3 ± 0.3 kg vs. noneater, 18.2 ± 0.2 kg; P < 0.05). The influence of eating creep feed during lactation on BW and ADG and the influence of suckling treatment never showed an interaction. We conclude that IS increases ADFI during lactation on a litter level and improves ADG in the first week and ADFI in the first and second weeks after weaning. No long-term effects on ADFI or ADG were observed throughout the finishing period. In the current experiment, in which creep feed intake was low, the percentage of eaters within a litter was not increased, suggesting that creep feed intake of piglets that were already eating was stimulated by IS. Further, piglets that were eaters during lactation had heavier BW up to 4 wk after weaning.

Key words: creep feed, feed intake, growth, performance, pig, weaning


INTRODUCTION

In the modern pig industry, piglets are usually weaned before 4 wk of age, thereby changing abruptly from a diet of highly digestible milk to a less digestible starter diet. As a result of this change and other stressors related to weaning, feed intake and growth are reduced after weaning (English, 1980) and piglets are more vulnerable to developing diarrhea and edema disease (van Beers-Schreurs et al., 1992). Intake of a sufficient amount of creep feed during lactation creates a more gradual transition at weaning and can reduce the occurrence of postweaning disorders (English, 1980). However, creep feed consumption during lactation is usually low and is also highly variable among piglets in a litter and between litters (Barnett et al., 1989; Pajor et al., 1991; Kuller et al., 2004b).
Although a review by Matte et al. (1992) showed contradictory results, previous work (Kuller et al., 2004b) demonstrated that intermittent suckling (IS), a management technique in which piglets are separated from the sow during a number of hours every day in the second half of lactation, increased creep feed intake before weaning and increased feed intake and growth shortly after weaning. However, in that study creep feed intake was determined at the level of the litter. Individual variation within the litter in relation to postweaning performance has not been studied. Also, long-term effects of IS on piglet performance have not been investigated.

The objective of the current study was to determine if the improved feed intake found during intensive (12 h/d) IS is important for postweaning performance of piglets until slaughter. Creep feed intake of the litters was assessed, and within litters, eaters and noneaters were distinguished using chromic oxide as an indigestible marker. These creep feed intake characteristics were related to postweaning performance.

MATERIALS AND METHODS

Animals and Housing

The experimental design was approved by the Ethical Committee of the Veterinary Faculty of Utrecht University (the Netherlands). Sixty-two sows (12 Dutch Landrace, 5 Yorkshire, and 45 Dutch Landrace × Yorkshire) were used between February and October 2002. Parity was 3.5 ± 0.3 in the control treatment and 3.8 ± 0.3 in the IS treatment and ranged from 1 to 11. Genotype and parity were equally distributed across treatments. During lactation, sows were housed individually in farrowing crates (2.4 × 1.8 m). The farrowing pen consisted of 1.95 m² of solid floor and 2.37 m² of slatted floor. This space included a piglet nest with an infrared lamp, a piglet drinking nipple, and a piglet feeder. Litter size at birth varied from 3 to 16 piglets but was standardized within 3 d after birth by cross-fostering within each batch. Litter size was 10.6 ± 0.2 after cross-fostering (range 9 to 13) and 9.7 ± 0.2 at weaning (range 7 to 13). Within the first 3 d after birth, piglets received an injection of 1 mL of iron dextran, were identified by ear tags, and males were castrated.

The experiment began on treatment d 0 (T0). To synchronize the beginning of IS within a farrowing batch, T0 was designated as the beginning of data collection. Piglets were born on 2.4 ± 0.3 d (range 1 to 5) before T0 in the control treatment and 2.0 ± 0.4 d (range –1 to 7) before T0 in the IS treatment. Maximum range of age within a farrowing batch was 4 d. Intermittent suckling always begun on d 14 of the treatment (T14), and weaning took place 11 d later (T25). Because weaning took place in the early morning, T25 was considered the first day after weaning. At weaning, the sows were moved to a mating room, and the piglets remained in the pen (weanling pigs). Five days after weaning, the piglets were moved as a litter to the weanling pens with 4 feeding spaces and 1 drinking nipple, with a floor space allowance according to Dutch animal welfare legislation (0.4 m²/pig, until 30 kg of BW).

At 8 wk of age (fattening pigs), 2 barrows and 2 gilts were randomly chosen from each litter and were transported to a finishing facility at another location in the Netherlands. In this facility, 4 to 8 pigs were housed together, depending on the size of the available pens. Each pen consisted of a partly slatted, concrete floor with 2 drinking nipples, and 1 feeding place, with floor space allowance according to Dutch animal welfare legislation (1 m²/pig, until 110 kg of live weight). The average group size was 7.2 ± 0.1 in the control treatment and 7.3 ± 0.1 in the IS treatment. Allotment to pens was based on BW within treatment (control vs. IS), with 1 treatment per pen. Pigs were slaughtered when their BW was approximately 107 ± 0.3 kg.

Treatments

There were 2 treatments, control and IS. Fourteen weekly farrowing batches were alternately allocated to each treatment: 7 control batches (31 sows, total) and 7 IS batches (31 sows, total). Each batch consisted of 4 to 5 sows. The batches were housed in separate rooms during lactation. The rooms (size, lights, flooring), equipment (size of the farrowing crates, feeders, drinking nipples), and environments (controlled climate) were comparable among all farrowing batches, and they were at the same facility. Only 1 treatment was applied per batch to avoid any influence of sucking in control sows because sucking is highly synchronized between animals in a barn. In the control treatment, piglets had access to the sow for 24 h/d. In the IS treatment, piglets were separated from the sow for 12 h each day (0930 until 2130) during T14 to weaning at T25. The piglets were separated by a removable wooden partition (height 65 cm) that was attached on both sides to the farrowing crate of the sow. During separation, IS piglets were allowed extra space at the back of the pen to create comparable floor space with that of the control piglets [IS, 3.75 m² vs. control, 4.32 m² (including the sow)]. Although the sow and piglets remained in the same pen, separation did not allow physical contact. During lactation, the lights were on between 0730 and 2330. After weaning, the lights were on between 0730 and 1630.

Feeding

The sows were fed a commercial lactational feed (9.1 MJ of NE/kg, 139 g of CP/kg, 8 g of lysine/kg, as-fed basis) at a level of 1% of BW at farrowing, plus 500 g/piglet (Dutch feeding tables, 1995), divided over 3 meals daily. Water was available ad libitum. Creep feed, based on milk products (34%, as-fed), soybeans, corn, sugar, vegetable oil, and a premix (12.8 MJ of NE/kg, 21.7% CP, 14.7% crude fat, 2.0% crude fiber, 5.2% ash, 1.46%
lysin, 0.86% Ca, 0.58% P, 160 mg of Cu/kg, 500 units of phytase/kg; as-fed basis) was offered to the piglets ad libitum from T7 onward and given in a round piglet trough. From T14 onward, a pig feeder with 4 feeding spaces was used. During T21 to T23, a gradual change (respectively, 40, 60, and 100% replacement) to a weaner diet based on milk products (18.5%), barley, soybeans, corn, sugar, vegetable oil, and a premix (11.4 MJ of NE/kg, 17.9% CP, 10.7% crude fat, 2.9% crude fiber, 5.8% ash, 1.25% lysine, 0.77% Ca, 0.59% P, 160 mg of Cu/kg, 500 units of phytase/kg; as-fed basis) was made, which was given until T31 of the experiment. From T32 onward, a series of 4 finishing diets were made, which was given until T31 of the experiment. From T32 onward, a series of 4 finishing diets were made, which was given until T31 of the experiment. From T32 onward, a series of 4 finishing diets were made, which was given until T31 of the experiment.

No food wastage was observed (the feeders were placed on a solid floor), feed that had disappeared was considered eaten.

**Measurements**

Individual piglet BW was assessed at birth and from T0 onward every week, until 4 wk after weaning (T52). Thereafter and until slaughter, the pigs were weighed every 4 wk. The ADG was calculated. At slaughter, the lean meat percentage was calculated using muscle and backfat thickness, measured on carcasses with the Henssey Grading Probe (Engel and Walstra, 1993). Creep feed residuals were weighed per litter at 7-d intervals. After weaning, feed intake was determined weekly per pen. No food wastage was observed (the feeder was placed on a solid floor). During lactation, creep feed was supplemented with 1% chromic oxide, which colored the piglet feces if the creep feed was eaten (Barnett et al., 1989; Bruininx et al., 2002). At T17, T21, T23, and T24, fecal samples were taken at 1100, using fecal loops (Instruvet, Amerongen, the Netherlands). The color of the samples was determined visually. Piglets with green feces were considered to have eaten creep feed (Barnett et al., 1989; Bruininx et al., 2002). Classification of the piglets into eaters and noneaters was based on the criteria of Bruininx et al. (2002) and previous experimental data (W. I. Kuller, unpublished data). One point was given to piglets that had green feces at the time of sampling, and 0 points was given when no green color was observed. When the color of the feces was inconclusive, 0.5 points was given. Piglets that had 0 points were noneaters. Piglets that had a sum of 1.5 points or greater for the 4 samples during lactation were designated as eaters. Piglets that had 0.5 or 1 point were nonclassified.

**Statistical Analysis**

**General.** All data were tested for normality using the UNIVARIATE procedure (SAS Inst. Inc., Cary, NC). The data were analyzed using the GLM and MIXED procedures of SAS. Correlations between the variables were calculated using the CORR procedure of SAS.

Data are presented as least squares means ± SEM. Differences were considered significant if P < 0.05. Relative 2-way interactions that are not mentioned were not significant.

**IS vs. Control During the Suckling and Weanling Periods.** Arcsine-transformed values of mortality rate per litter were normally distributed and analyzed in the following model (PROC MIXED): $Y_{ijkt} = \mu + T_i + B_j(T_i) + L_k + e_{ijk} + TS_{ij} + e_{ij}$, where $T_i$ = treatment, $B_j$ = batch (nested within treatment), and $L_k$ = litter as a random effect.

The ADFI and ADG of the piglets and piglet BW were analyzed as litter characteristics using the following linear model (PROC MIXED): $Y_{ijk} = \mu + T_i + B_j(T_i) + L_k + a_{ijk} + e_{ijk}$, where $T_i$ = treatment, $B_j$ = batch (nested within treatment), and $a_{ijk}$ = age of the piglets at T0. From T14 onward, feed intake between T7 and T14 and BW of piglets at T14 (beginning of IS) was also used as a covariate in modeling ADFI. Breed and parity of the sow were never significant and were therefore omitted from the model.

**IS vs. Control During the Fattening Period.** The ADG and BW of the piglets were analyzed on the piglet level using the following linear mixed model (PROC MIXED): $Y_{i jkl} = \mu + T_i + a_{ijkl} + w_{14ijkl} + sex_j + pen_k + e_{ijkl}$, where $T_i$ = treatment, $a_{ijkl}$ = age of the piglets at T0, $w_{14ijkl}$ = BW of the piglets at T14 (beginning of IS), and $pen_k$ = pen as a random effect. In the analysis of slaughter BW and percentage of lean meat, duration of the fattening period was also included as a covariate. Feed intake during the entire fattening period, on a pen level, was analyzed in a linear model (PROC GLM): $Y_{ij} = \mu + T_i + ts_{ij} + e_{ij}$, where $T_i$ = treatment and $ts$ = time to slaughter. In the analysis of mortality, $ts_{ij}$ was omitted from the model. The feed to gain ratio during the entire fattening period was calculated (on a pen level) as the feed disappearance in a pen divided by the total BW gain of the pigs in this pen. Feed to gain ratio was analyzed in a GLM: $Y_{ij} = \mu + T_i + ts + e_{ij}$ with $T_i$ = treatment and $ts$ = time to slaughter. Group size was never significant and was therefore omitted from the model.

**Eaters vs. Noneaters.** The ADG and BW of the piglets were analyzed using the following linear mixed model (PROC MIXED): $Y_{ij} = \mu + Eater_i + a_{ijkl} + bw_{ijkl} + sex_j + SP_k + e_{ijkl}$, where $Eater_i$ = eater or noneater, $a_{ijkl}$ = age of the piglets in relation to T0, $bw_{ijkl}$ = BW of piglets at T14 (beginning of IS) or BW at slaughter, and $SP_k$ = sow (for the suckling period) or pen (for the weanling and fattening period) as a random effect. Treatment and the interaction of treatment × eater were never significant ($P > 0.50$) and were therefore omitted from the model. In the analysis of BW at slaughter and the percentage of lean meat, the duration of the fattening period was also included as a covariate. Differences in the number of eaters between the treatments were tested using the $\chi^2$ test in SAS.

**RESULTS**

**Piglet Mortality**

No difference was found between treatments in number of piglets at birth (IS, 11.3 ± 0.3 vs. control, 11.1 ±
Table 1. Causes of mortality and culling of fattening pigs, d 52 to slaughter

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>IS</th>
</tr>
</thead>
<tbody>
<tr>
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<td>—</td>
</tr>
<tr>
<td>Lung disease</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Meningitis</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Sudden death</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>Lameness</td>
<td>3</td>
<td>6</td>
</tr>
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<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>9</td>
</tr>
</tbody>
</table>

1In the control treatment, the piglets were continuously with the sow during lactation. Piglets in the intermittent suckling (IS) treatment were separated from the sow for 12 h/d (0930 to 2130) beginning 11 d before weaning at 4 wk.
2Diagnosis on the basis of postmortem examination.

0.5), at weaning (IS, 9.7 ± 0.2 vs. control, 9.5 ± 0.2), or at the end of the weaning period (IS, 9.1 ± 0.3 vs. control, 8.7 ± 0.3). Piglet mortality per litter from birth to weaning did not differ between the treatments (IS, 4.6 ± 0.1% vs. control, 5.6 ± 0.1%; P = 0.66). In both treatments, the main cause of death of piglets from birth to weaning was crushing by the sow and death because of weakness (small piglets). Mortality per litter from weaning until T52 did not differ between treatments (IS, 1.7% ± 0.2 vs. control, 2.2% ± 0.2; P = 0.68).

Mortality and culling (Table 1) in the finishing period was high (IS, 7.4% vs. control, 11.4%) for Dutch standards, but was not affected by treatment (P = 0.30).

Feed Intake

Total creep feed intake during lactation ranged from 8 to 1,056 g/piglet in the IS litters and from 9 to 513 g in control litters. Piglets that were younger at T0 had lower ADFI during lactation (r = 0.30, P < 0.02) and at the beginning of IS, ADFI (although still very low) was greater in control litters (Table 2). Therefore, ADFI was corrected for age at T0 and for creep feed intake before treatment. Average daily feed intake was also corrected for BW at T14 because this was significant in the model.

After beginning IS at T14, ADFI was greater in IS litters than in control litters between T14 and T21 and between T21 and T24. Total creep feed intake during the treatment period (T14 to T24) was 284 ± 27 g/piglet in IS litters and 83 ± 28 g/piglet in control litters (P < 0.001; corrected for feed intake during T7 to T13).

The ADFI of the weaning pigs was greater (P < 0.05) in IS litters from T25 (weaning) to T31 and from T32 to T38 (Table 2). No difference was found from T39 to T52 (weaning period) or from T52 to slaughter (fattening period) (IS, 2.2 ± 0.1 vs. control, 2.0 ± 0.1 g-piglet⁻¹·d⁻¹; P = 0.46).

Correlation coefficients of creep feed intake between 1 wk and the next week varied from 0.38 to 0.83 (P < 0.01), irrespective of treatment. Therefore, litters with greater feed intake in 1 wk had greater feed intake in the following week. The following relationship between creep feed intake during lactation (ADFI_lact) and feed intake in the first week after weaning (ADFI_aw) was found: ADFI_lact = 136 + 0.26 × ADFI_aw (R² = 0.69). The interaction treatment × ADFI_lact was not significant (P = 0.11).

ADG and Weight of Piglets

The ADG of piglets did not differ between treatments before the beginning of IS at T14 (IS, 232 ± 29 vs. 235 ± 29 g/piglet; P = 0.79). The ADG was lower in the IS treatment during T14 to T20 (IS, 198 ± 40 vs. control, 308 ± 40 g/piglet; P < 0.001) and during T21 to T24 (IS, 176 ± 10 vs. control, 246 ± 10 g/piglet; P = 0.005). The first week (T25 to T31) after weaning, however, ADG was greater in IS piglets (IS, 177 ± 14 vs. control, 106 ± 14 g/piglet; P < 0.001). No difference was found between treatments from T31 to T52 (IS, 755 ± 77 vs. control, 765 ± 77 g/piglet; P = 0.97) or thereafter until slaughter (IS, 795 ± 17 vs. control, 789 ± 17 g/piglet; P = 0.80).

Weight of piglets at T14 did not differ between treatments (Table 3). At T21 and at weaning (T25), piglet BW was less in the IS treatment. Within 7 d after weaning, however, this difference in piglet BW had disappeared. No differences in BW were found during the remainder of the weaning or fattening period.

In both treatments, piglets that had greater BW gains during the lactational period also had greater BW gains during the weaning period (IS, r = 0.36, P = 0.04 and control, r = 0.52; P < 0.001). This positive relationship also existed between the weaning and the fattening period in the control treatment (r = 0.52, P < 0.001) and tended to exist in the IS treatment (r = 0.16; P = 0.09). A positive relationship was found between litter creep intake...
The effect of treatment and the interaction between treatment and eater were not significant in the analysis of ADG and BW and were therefore omitted from the model.

In the IS treatment, 85 pigs had more than 1.5 points (eaters), 168 pigs had 0 points (non eaters), and 48 pigs had 0.5 or 1 point (nonclassified). In the control treatment, this distribution was 67, 190, and 40 pigs, respectively. On average, an IS litter consisted of 23.0 ± 4.5% eaters, 62.8 ± 3.9% noneaters, and 13.9 ± 1.9% of nonclassified pigs. A control litter consisted of 19.0 ± 4.1% eaters, 69.8 ± 3.2% noneaters, and 11.3 ± 2.0% of nonclassified pigs. Overall distribution of eaters, noneaters, and nonclassified pigs within litters did not differ between treatments (P = 0.15). Overall, more gilts than barrows were designated as eaters (30% of females vs. 21% of males, P = 0.03). From this point onward, focus will be only on eaters and noneaters.

The ADG tended to be greater in noneaters from T0 to T6 (eater, 249 ± 21 g/piglet; noneater, 259 ± 21 g/piglet; P = 0.09) and from T7 to T13 (eater, 341 ± 25 vs. noneater, 353 ± 25 g/piglet; P = 0.07). From T14 to T20, no difference in ADG was found (eater, 316 ± 38 vs. noneater, 325 ± 37 g/piglet; P = 0.3). During the last days of lactation (T21 to T24) ADG was greater for eaters (eater, 243 ± 18 vs. noneater, 209 ± 17 g/piglet; P = 0.007). After weaning ADG was greater for eaters during T25 to T31 (eater, 199 ± 11 vs. noneater, 106 ± 8 g/piglet; P = 0.001), T32 to T38 (r = 0.45, P < 0.013) and in the IS treatment during T39 to T45 (r = 0.36, P = 0.05). Gain to feed ratio during the fattening period was 0.39 ± 0.01 in the IS treatment and 0.37 ± 0.01 in the control treatment (P = 0.26). No differences were found among IS and control piglets in lean meat percentage (Table 3).

**Eaters vs. Noneaters**

The effect of treatment and the interaction between treatment and eater were not significant in the analysis of ADG and BW and were therefore omitted from the model.

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Table 3. Body weight (kg), time to slaughter, and lean meat percentage of piglets in the control and intermittent suckling (IS) treatments, and of eaters and noneaters, at different days in the suckling, weaning, and fattening period.

<table>
<thead>
<tr>
<th>Item</th>
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<th>IS</th>
<th>SE</th>
<th>Eater</th>
<th>Noneater</th>
<th>SE</th>
<th>Eater</th>
<th>Noneater</th>
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<tbody>
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<td>1.6</td>
<td>1.5</td>
<td>0.04</td>
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<td>0.1</td>
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</tr>
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<td>T53</td>
<td>19.1</td>
<td>18.9</td>
<td>0.3</td>
<td>20.3</td>
<td>18.2</td>
<td>0.3</td>
<td>20.3</td>
<td>18.2</td>
<td>0.3</td>
</tr>
<tr>
<td>T81</td>
<td>39</td>
<td>39</td>
<td>1.0</td>
<td>40</td>
<td>39</td>
<td>0.7</td>
<td>40</td>
<td>39</td>
<td>0.7</td>
</tr>
<tr>
<td>T109</td>
<td>62</td>
<td>61</td>
<td>1.3</td>
<td>63</td>
<td>62</td>
<td>0.9</td>
<td>64</td>
<td>62</td>
<td>0.9</td>
</tr>
<tr>
<td>T137</td>
<td>86</td>
<td>85</td>
<td>1.2</td>
<td>86</td>
<td>85</td>
<td>0.7</td>
<td>86</td>
<td>85</td>
<td>0.7</td>
</tr>
<tr>
<td>Time to slaughter, d</td>
<td>107</td>
<td>108</td>
<td>0.5</td>
<td>108</td>
<td>107</td>
<td>0.6</td>
<td>56.3</td>
<td>56.0</td>
<td>0.2</td>
</tr>
<tr>
<td>Lean meat, %</td>
<td>56.3</td>
<td>56.0</td>
<td>0.2</td>
<td>56.0</td>
<td>56.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Data collection began on treatment d 0 (T0). The piglets were born on 2.4 ± 0.3 d (range 1 to 5) before T0 in the control treatment and 2.0 ± 0.4 d (range 1 to 7) before T0 in the IS treatment. This time sequence applies also to the other times. For T0 to T53, the data were based on 31 litters; for T81 onward, the data were based on 112 piglets.

2 In the control treatment, the piglets were continuously with the sow during lactation. Piglets in the IS treatment were separated from the sow for 12 h/d (0930 to 2130) beginning 11 d before weaning at 4 wk.

3 Creep feed was supplemented with 1% chromic oxide, which colored the piglet feces green if creep feed was eaten. Four fecal samples were taken: green feces = 1 point; no green color = 0 points; inconclusive color = 0.5 point. Noneaters: 0 points in 4 samples; eater, 1.5 points or greater for the 4 samples. Eaters: for T0 to T53, the data were based on 152 piglets; for T81 onward, the data were based on 62 piglets. Noneaters: for T0 to T53, the data were based on 358 piglets; for T81 onward, the data were based on 134 piglets.

a,b Row values (least squares means ± SEM) with different superscripts differ between suckling treatment or consumption category (P < 0.05).

Intermittent suckling and creep feed intake
during the fattening period (eater, 792 ± 16 vs. non-eater, 794 ± 13 g/piglet; \( P = 0.90 \)).

During the suckling period, no difference in BW was found between eaters and noneaters except for T14, where the noneaters were heavier (Table 3). During the weanling period (T25 to T52), however, eaters were at all times heavier than noneaters. From T81 onward, 4 wk after piglets had been moved to the finishing facility, no difference was observed in BW among eaters and noneaters in the IS treatment. No differences were found among eaters and noneaters in lean meat percentage (Table 3).

**DISCUSSION**

Intermittent suckling increased creep feed intake by suckling piglets during the last 11 d of lactation, which is in agreement with a previous study (Kuller et al., 2004c). As expected, IS resulted in lower BW at weaning (Thompson et al., 1981; Henderson and Hughes, 1984; Kuller et al., 2004c). This initial growth check during lactation in the IS group was compensated during the first week after weaning. Previous studies did not investigate long-term effects of IS on piglet performance (Grinch and McKay, 1985; Chapple et al., 1989; Costa and Varley, 1995). Moreover, sometimes piglets were weaned at an age of 49 d (Smith, 1960), which is not compatible with current production methods. One study mentioned that time needed to reach 90 kg of live BW was not influenced by IS (Henderson and Hughes, 1984), but details about ADG and ADFI were not provided. In our experiment, IS improved ADG during the first week and increased ADFI during the first and second week after weaning but had no further positive effects on performance (BW gain and ADFI) during the fattening period and meat percentage at slaughter. The latter might be a result of the overall lower feed intake in the current experiment and the small difference in creep feed intake between the control and the IS treatment.

Intermittent suckling did not increase the percentage of eaters within a litter as was expected; the percentage of eaters in control litters was 19% and was 23% in IS litters. Apparently, IS increased creep feed intake of piglets that were already eating before the period of separation, instead of increasing the number of eating piglets within a litter. Animals within a litter that were eating consumed considerable amounts of creep feed. Considering that in the IS and in the control treatment only 23 and 19% of the animals were classified as eaters, IS piglets that were eaters consumed 1,235 g and control piglets that were eaters ate 437 g, the first being greater than the 600 g reported by English (1980). The question remains whether the percentage of eaters would be increased in experiments in which greater litter creep feed intakes were found.

Creep feed intake was much less in the current experiment than in a previous experiment (Kuller et al., 2004c) in IS (231 vs. 686 g) and control piglets (147 vs. 314 g). The reason for these low feed intakes in the current experiment is not clear. The experiment was carried out 2 yr later in the same season, on the same farm and with the same population of sows with comparable litter size and weaning weights. Weight loss of the sow was on average 3 kg greater in the current than in our previous experiment (Kuller et al., 2004a,c). This suggests that milk intake per piglet might have been greater in the current experiment, which would decrease the need for creep feed. However, such a supposed greater milk intake did not result in heavier piglets at weaning, as might be expected. The lower intakes cannot be attributed to the chromic oxide added to the feed because chromic oxide does not affect palatability (W. I. Kuller, unpublished data).

Piglets designated as eaters during lactation had heavier BW and ADG than noneaters until 28 d after weaning. This agrees with findings of Bruininx et al. (2002) who studied the effect of preweaning creep feed consumption on postweaning performance. In a previous experiment (Kuller et al., 2004b), piglets that were designated as eaters also had greater net absorption in the small intestine at d 4 after weaning. So, stimulation of creep feed intake during lactation may improve performance of newly weaned piglets. The effect of creep feed intake, however, on postweaning diarrhea was difficult to assess in the current experiment because it is rarely observed on this farm.

In a previous experiment (Kuller et al., 2004c), IS litters with little or no creep feed intake during lactation tended to have greater BW gains after weaning than control litters with comparable feed intakes. We therefore speculated that these positive effects might be mediated by reduction in stress at weaning in IS piglets. In the current experiment, however, the relationship between preweaning feed intake and feed intake and growth shortly after weaning were not affected by treatment. Thus, increased performance of IS piglets shortly after weaning (increased feed intake and ADG) may not have been influenced by reduced stress at weaning. Possibly, the combination of the overall lower creep feed intake and the absence of an eater \( \times \) treatment interaction on performance after weaning may have resulted in the fact that IS did not have positive or negative effects on long-term performance to slaughter.

The percentage of animals classified as eaters is dependent on classification criteria and method of classification. Classification of animals as eaters, noneaters, and nonclassified was based on visual assessment of green coloring of feces, which resulted from intake of creep feed that contained chromic oxide (Barnett et al., 1989; Bruininx et al., 2002; W. I. Kuller, unpublished data). In the latter experiment (W. I. Kuller, unpublished data), piglets were forced fed during 2 successive days of lactation at different levels of creep feed, and then excretion patterns of chromic oxide were assessed by visual examination of the feces. That experiment showed that piglets eating considerable amounts of creep feed could be distinguished accurately as eaters.
Intermittent suckling and creep feed intake

because excretion of green feces was abundant. Animals with a low feed intake, however, often had 1 or more inconclusive samples (W. I. Kuller, unpublished data). To guarantee selection of animals that consumed considerable amounts of creep feed in the present experiment, animals were considered eaters when, out of 4 samples, they had at least 1 positive and 1 inconclusive sample or 3 inconclusive samples. Unfortunately, no alternative or more accurate marker is currently available to identify eaters and noneaters or to measure individual creep feed intake in suckling piglets under farm conditions.

The IS increased ADFI during lactation and shortly after weaning. Piglets consuming substantial amounts of creep feed (designated as eaters) showed greater BW gains and BW during the first 4 wk after weaning. However, IS did not increase the percentage of eaters within a litter during lactation, and no long-term effects on ADG or ADFI were observed throughout the finishing period.

**LITERATURE CITED**


