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Effects of Creep Diet Complexity on Individual Consumption Characteristics and Growth Performance of Neonatal and Weanling Pigs[1]

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Summary
In Exp. 1, 96 sows (PIC C29) and their litters were used to determine the effects of creep diet complexity on preweaning performance and the proportion of piglets consuming creep feed. The experimental treatments were: (1) no creep feed (n = 26), (2) simple creep diet (n = 26), and (3) complex creep diet (n = 44). Pigs fed the complex creep diet had greater (*P* < 0.03) ADG and tended to have greater (*P* < 0.06) total gain than pigs fed the simple creep diet, with no creep pigs intermediate. Litters fed the complex creep diet consumed twice the total (2.73 vs. 1.37 lb; *P* < 0.0006) and daily (0.91 vs. 0.45 lb; *P* < 0.0006) creep feed intake of litters fed the simple creep diet. The high-complexity creep diet improved (*P* < 0.0001) the proportion of eaters from 28% to 68%. A greater (*P* < 0.10) proportion of eaters were nursing in the middle and posterior teats (57% and 52%, respectively) than in the anterior teats (38%). In Exp. 2, 675 pigs from Exp. 1 (initial BW 14.1 lb and 21.2 ± 0.2 d) were used to determine whether social facilitation occurs between eaters and non-eaters in commercial nursery groups. The treatments were: non-eater group (pigs that were not provided any creep feed or non-eaters of creep feed), eater group (pigs that positively consumed creep feed), and mix group (pigs that were 51% non-eaters and 49% eaters). Each treatment had 25 pigs per pen and 9 replications (pens). In the initial 3 d postweaning, eaters had greater (*P* < 0.01) ADG and (*P* < 0.002) ADFI than non-eaters, with the mix group being intermediate. Overall ADG of the eater group was 6.2% higher (*P* < 0.05) than that of the non-eater group. For social facilitation to occur, weight gains of non-eaters in the mix pens should be either (1) closer to the weight gains of eaters in the mix pen or (2) greater than the weight gains of the non-eater group. Results showed that non-eaters within the mix pens failed both criteria. In conclusion, the high-complexity creep diet improved preweaning ADG, litter creep feed intake, and the proportion of eaters. Eaters had improved postweaning feed intake, daily gains, and weight uniformity and reduced postweaning lag. Mixing eaters with non-eaters within pens in large commercial groups did not stimulate feed intake and daily gains of non-eaters, which indicates that social facilitation did not occur.

Key words: behavior, creep feeding, diet complexity

Introduction
Maximizing postweaning pig performance is essential in improving lifetime growth efficiency and productivity. However, weaning is often characterized by a period of low feed intake caused by physical, physiological, and behavioral challenges that may result in a growth check and affect postweaning growth rates. Thus, improving feed intake

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of weaned pigs during this transition period may be critical in improving postweaning growth. Creep feeding studies that evaluated individual pigs rather than whole litters have consistently demonstrated the benefit of creating "eaters," which are pigs that positively consumed creep feed, on postweaning feed intake and growth. Identifying factors that can increase creep feed consumption and the proportion of pigs consuming creep feed may be important in improving the success of this practice.

It is hypothesized that creep diet complexity may be an important factor in stimulating feed intake. In previous studies, significant improvements were observed in both preweaning and postweaning feed intake when litters were fed a creep diet with greater complexity. However, no research has been conducted to evaluate the effects of creep diet complexity on individual consumption characteristics. It is also commonly speculated that weaned pigs that have preweaning experience to solid food may facilitate non-experienced pigs to discover food sources and initiate feeding when these pigs are housed together in large nursery groups. That is, pigs that have not consumed dry feed may "learn" from those that are eating. However, evidence of this social learning behavior is limited. Therefore, the objectives of this study were to determine (1) the effects of creep diet complexity on preweaning performance and the proportion of piglets consuming creep feed (Exp. 1) and (2) whether social facilitation occurs between eaters of creep feed and pigs that did not consume or had not been offered creep feed in a commercial nursery (Exp. 2).

Procedures

The experimental protocols used in this study were reviewed and approved by the Kansas State University Institutional Animal Care and Use Committee.

Experiment 1

A total of 96 sows (PIC C29) and their litters were used in this study conducted at a commercial sow facility in northeastern Kansas. Sows used in this experiment were from 3 batches of sows farrowed in February 2009. Cross-fostering was performed within 24 h after farrowing. At the start of the creep feeding experiment (d 18), sows were blocked according to date of farrowing and litter size and allotted to 3 experimental treatments in a randomized complete block design. In Treatment 1, litters were not provided any creep feed (no creep). In Treatments 2 and 3, litters were provided either a simple or complex creep diet, respectively (Table 1). There were 26 replicates for Treatments 1 and 2 and 44 replicates for Treatment 3. The higher number of replicates for Treatment 3 was intended to increase the number of eaters that were used for Exp. 2.

The simple creep diet contained 60% milo, 32% soybean meal, and 3% choice white grease, which was identical to the lactation diet offered to the sows. It was formulated to contain 1,589 kcal ME/lb and 0.97% standardized ileal digestible (SID) lysine. The complex creep diet was composed of 30% pulverized oat groats and 25% spray-dried whey with specialty protein sources such as 10% extruded soy protein concentrate, 6% spray-dried porcine plasma, and 6% select menhaden fish meal. It also contained 5% lactose and 5% choice white grease. The diet included very low levels of soybean meal (2.3%) and corn (6.15%). The diet was formulated to contain 1,585 kcal ME/lb, 1.56% SID lysine, and 23% lactose. Chromic oxide was added to both diets at 1.0% to serve as a fecal marker. The simple creep diet was in meal form, and the complex creep diet was in pellet form (2-mm pellets). Both creep diets were offered ad libitum from d 18 until weaning on d 21 in a rotary creep feeder with hopper (Rotecna Mini Hopper Pan, Rotecna SA, Spain). A single lactation diet (1,589 kcal ME/lb, 0.97% SID lysine) was used in the experiment. Sows had free access to feed throughout lactation. Water was available at all times for sows and their litters through nipple and bowl drinkers, respectively.

Piglets were weighed individually at d 0 (birth), 18 (start of creep feeding), and 21 (weaning). A sufficient amount of creep feed was placed in the hopper of the creep feeder at the start of the study (d 18), and the initial weight of the creep feeder was weighed and recorded. Feeders were weighed daily to calculate daily and total creep feed intake for each litter. All creep-fed pigs were evaluated for consumption category at d 20 (48 h after creep feed was provided) by evaluating fecal material for the presence of green color provided by the chromic oxide marker in the creep diet. On the morning of the evaluation day, a fecal swab was obtained from each piglet. The pig was categorized as an eater if a green color was visible in the fecal sample. Piglets that tested negative on the first fecal sampling were sampled again 3 to 12 h before weaning (d 21). Piglets were categorized as non-eaters when no green color was detected in any of the collected samples. General health of the sows and piglets was checked daily, and use of medication was monitored. Temperature in the farrowing facility was maintained at a minimum of 20°C, and supplementary heat was provided to the piglets with heat lamps when needed.

The relationship between creep consumption category and teat order was also determined. Teat order was defined as the specific teat (pair) nursed by each piglet with respect to the anatomical location of the nursed mammary gland. In this study, individual pigs categorized as eaters were marked on their back, and non-eaters were unmarked. At d 20 (within 24 h before weaning), suckling bouts from 20 litters were photographed with a digital still camera. Litters with less than 50% eaters were chosen to obtain a good distribution of eaters and non-eaters. The photograph of each suckling bout was then used to determine teat location and rank of each individual piglet in the litter. A distribution of teat order in three classes was also made on the basis of the preferred teat pair suckled by the piglets: anterior (teat pairs 1 and 2), middle (teat pairs 3, 4, and 5), and posterior (teat pairs 6 and 7).

Experiment 2

From a total of 1,024 pigs weaned in Exp. 1, 675 pigs (PIC C29 × 327, initial BW 14.1 lb and 21.2 ± 0.2 d) were allotted to 3 treatments in a completely randomized design. The treatments for this study were: Treatment 1 - pigs that were not provided any creep feed or pigs that did not consume creep feed even when offered (non-eater), Treatment 2 - pigs that positively consumed creep feed (eater), and Treatment 3 - pigs that were 52% non-eaters and 48% eaters (mix). Eaters were used regardless of the complexity of the creep diet they consumed. Each treatment had 25 pigs per pen and 9 replications (pens). Each pen was equipped with one 10-hole self-feeder (Farmweld, Inc., Teutopolis, IL) and a cup drinker to provide ad libitum access to feed and water. The experiment was conducted at a commercial nursery facility in northeastern Kansas.

All pigs were fed a budget of 1 and 2 lb/pig of commercial SEW and transition diet, respectively. Pigs were fed a standard Phase 2 diet until the end of the study (d 28 postweaning). The total amount of feed offered in the first 3 d postweaning was recorded. To determine total and daily feed intake in the initial 3 d, feed was vacuumed out of the feeders and weighed. Pigs were weighed at d 0 (weaning), 3, 7, and 28 postweaning to calculate for periodic and cumulative ADG.

Data Analysis

In Exp. 1, data were analyzed as a randomized block design using the PROC MIXED procedure of SAS (SAS Institute Inc., Cary, NC) with litter as the experimental unit. The model included creep diet complexity and block as the fixed and random effect, respectively. Except for farrowing group 1, each block included 1 litter each of the no creep and simple creep treatment and 2 litters of the complex creep treatment. The extra litters fed complex diet were intended to provide an increased number of eaters for Exp. 2. The effects of creep diet complexity, weight category, and teat location on the proportion of eaters were analyzed using the Chi-square test in SAS. When treatment effect was a significant source of variation, differences were determined using the PDIFF option of SAS. In Exp. 2, data were analyzed as a completely randomized design using the PROC MIXED procedure of SAS with pen as the experimental unit. The model included consumption category and block as the fixed and random effects, respectively. When treatment effect was a significant source of variation, differences were determined using the PDIFF option of SAS. To test for evidence of social facilitation, the effect of consumption category was compared within the mix pens using PROC MIXED of SAS. Statistical significance and tendencies were set at $P < 0.05$ and $P < 0.10$ for all statistical tests.

Results and Discussion

Experiment 1

Sows had an average parity of 4.3 ± 0.4 and lactation length of 21.2 ± 0.2 d (Table 2). The average litter size at d 18 and 21 (weaning) was 10.7 ± 0.3 and 10.5 ± 0.3 piglets, respectively. Mortality rate during the creep feeding period (d 18 to 21) was 1.9% for all three treatments. Results indicated no differences ($P < 0.74$) in pig weaning weights; however, pigs fed the complex creep diet had greater (12.9%; $P < 0.03$) preweaning daily gains and tended to have higher (11.1%; $P < 0.06$) total gain than pigs fed the simple creep diet, with no creep pigs being intermediate. Total and daily gains of litters fed the complex creep diet were 4.1% and 5.0% higher than litters fed the simple creep diet, respectively; however, differences were not significant ($P > 0.58$). Likewise, there were no differences ($P < 0.70$) in litter weaning weights. This positive effect of increased diet complexity on preweaning weight gains may be related to the quality of the two creep diets used. The complex creep diet was formulated to match the digestive capacity of young pigs, so feed digestibility, palatability, and antigenic properties of the feed were considered. These same requirements were disregarded in the design of the simple creep diet. However, the lack of differences in pig and litter preweaning gains between the creep-fed and no creep pigs suggests that any benefit of increasing creep diet complexity was insufficient to see appreciable effects, especially when the duration of feeding and the amount consumed is considered.

Litters fed the complex creep diet consumed twice the total (2.73 vs. 1.37 lb; $P < 0.0006$) and daily (0.91 vs. 0.45 lb; $P < 0.0006$) creep feed intake of litters fed the simple creep diet (Figure 1). Creep diet complexity also influenced the proportion of pigs consuming creep feed in whole litters (Figure 2). Increasing the complexity of the creep diet improved ($P < 0.0001$) the proportion of eaters from 28% to 68%. This suggests that the higher creep feed intake observed in litters fed the complex creep diet was due to a greater number of pigs positively consuming creep feed. The proportion of eaters achieved in this study for the complex creep diet was consistent with our previous studies, in which the same creep diet, feeder design, and creep feeding duration were used. Relative to all the non-dietary and dietary factors previously investigated, diet complexity had the greatest influence in creating eaters. This indicates that the complexity of the creep diet may be one of the most important factors in stimulating individual pigs in the litter to consume creep feed.

Within the litters provided creep feed, there was no significant interaction between creep diet complexity and consumption category on individual pig performance prior to weaning (Table 3). Pigs that became eaters in creep-fed litters were lighter ($P < .0001$) at d 18 and at weaning regardless of the complexity of the creep diet. Eaters also tended to have lower ($P < 0.08$) preweaning total gains than non-eaters. Daily gains of eaters were 7.2% and 5.6% lower than those of non-eaters, but differences were not significant ($P > 0.12$). The distribution and performance of eaters and non-eaters according to weight category were also compared (Table 4). There were significant differences ($P < 0.0002$) in pig weights at d 18 and weaning, total gain, and daily gains between the bottom, middle, and top weight category for pigs fed either the simple or complex creep diet. A greater ($P < 0.0001$) percentage of eaters was observed among pigs in the bottom weight category for both creep-fed treatments; 47% in the simple creep diet and 83% in the complex creep diet. There was no interaction ($P > 0.50$; data not shown) between creep consumption category and weight class on any growth parameters in either the simple or complex creep treatments. In the current study, pigs identified as eaters were 7% to 8% smaller in body weight and were gaining 5% to 6% less than non-eaters prior to weaning regardless of the complexity of the creep diet. The higher proportion of eaters on the bottom weight category suggests that creep feeding is beneficial to smaller piglets within litters as an alternative source of nutrients during lactation.

It has been suggested that teat order may be related to creep feed consumption, in that pigs nursing in the posterior (less productive) teats may consume creep feed more readily than their counterparts nursing in anterior (more productive) teats. The relationship between teat order and creep consumption category is shown in Table 5. Overall, 37%, 45%, and 17% of the pigs were found nursing in the anterior (teat pairs 1 and 2), middle (teat pairs 3, 4, and 5), and posterior (teat pairs 6 and 7) teats. There were 49% eaters and 51% non-eaters in the litters evaluated. Results showed a tendency ($P < 0.10$) for differences in the proportion of eaters according to teat location. A greater proportion of eaters were found nursing in the middle and rear teats (57% and 52%, respectively) than in the front teats (38%). Typically, piglets that nurse from the rear teats are smaller and less competitive than those that nurse from front teats. The lower ability of smaller pigs to compete at the udder and extract milk may predispose these pigs to consume more creep feed when it is offered. The higher rate of eaters in the middle and rear teats in the current study may support this assumption.

Experiment 2

The effect of creep consumption category on nursery pig performance and weight variation within pens is shown in Table 6. The initial weight of the eater group (at d 21) was numerically lower than that of the non-eater group and tended ($P < 0.08$) to be lower than that of the mix group. The lower initial weight of the eater group was expected because it was a characteristic of the population of eaters weaned from Exp. 1. In the initial 3 d postweaning (d 21 to 24 of age), eaters had 43% greater (0.31 vs. 0.21 lb; $P < 0.01$) daily gains than non-eaters, with the mix group being intermediate. The mix group tended to have higher ($P < 0.08$) daily gains than the non-eater group. This was mainly due to differences in initial feed intake (first 3 d postweaning) between the groups. The eater group had higher ($P < 0.002$) ADFI than the non-eater and mix groups. The mix group also had higher ($P < 0.02$) ADFI than the non-eater group. There were no ($P > 0.23$) differences in F/G between the eater, non-eater, and mix groups during the initial 3-d period.

From d 3 to 7 postweaning (d 25 to 28 of age), there were no ($P > 0.66$) differences in daily gains between the three groups. In the first 7 d postweaning (d 21 to 28), the eater and mix groups had 12% to 10% higher overall daily gains, but differences were not significant ($P > 0.15$). Pig weights were similar ($P > 0.13$) between the three groups at d 24 and 28. From d 29 to 49, the eater group tended ($P < 0.07$) to have higher daily gains than the non-eater group, with the mix group being intermediate. Overall, daily gain of the eater group was 6.2% higher ($P < 0.05$) than that of the non-eater group, with the mix group being intermediate. There were no differences ($P > 0.14$) in pig weights at d 49 between the three groups. Though weight differences were numerical, it is worthy to note that despite starting at a lighter weight, eaters were the heaviest group and were 3% heavier (34.1 vs. 33.1 lb) than the non-eater group at d 49.

The difference in postweaning feed intake between eaters and non-eaters has been fairly consistent. Interestingly, most previous studies provided creep feed for 14 to 21 d and pigs were weaned at an older age (ranging from 24 to 31 d), whereas the current study had a shorter creep feeding duration (3 d prior to weaning) and pigs were weaned at a younger age (21 d). These results suggest that individual pigs that do consume creep feed prior to weaning consume more feed and achieve greater daily gains postweaning even when fed creep for a short duration and weaned at 3 wk of age. It is not known if the same responses can be expected in younger (< 3 wk) weaning ages.

At d 21 (weaning), there were no differences ($P > 0.16$) in initial pen CV between the three groups. However, the weight variation in the eater group was 1.3 to 1.6 percentage units higher than in the non-eater and mix groups. There were no differences in pen CV at d 24, 28, and 49; however, the reduction in pen CV in the eater group tended to be greater (-3.2% vs. -0.9%; $P < 0.06$) at d 28 than in the non-eater group, with the mix group being intermediate. Overall (d 21 to 49), the change in pen CV for the eater group was greater (-5.6%; $P < 0.03$) than for both the non-eater and mix groups. These results suggest that individual consumption characteristics of pigs prior to weaning may be an important factor in improving pig weight uniformity in the nursery. The greater reduction in weight variation in eater groups may possibly be driven by faster growth of smaller pigs, especially during the first week postweaning.

Creep consumption category influenced ($P < 0.0001$) the percentage of fall back pigs during the initial 3 d postweaning (Figure 3). Fall back pigs were those that did not gain weight or lost weight in the first 3 d postweaning. Overall, 25% of the total population of weaned pigs in the study did not gain or lost weight during the initial 3 d postweaning. However, eaters of creep feed responded better to weaning, with only 17% considered fall back pigs. For no creep pigs and non-eaters, 28% and 29%, respectively, of pigs lost weight. This indicates that positive consumption of creep feed preweaning can reduce postweaning lag, despite a large proportion of eaters being smaller than non-eaters and no creep pigs.

Social facilitation is a rudimentary form of social learning in which individuals discover resources by following group members that have already learned to exploit these resources. If social facilitation really occurs, transmission of information in locating and consuming a new food source between experienced (eaters) and inexperienced (non-eaters) pen mates may be important in reducing problems with low feed intake in newly weaned pigs and improving weaning transition. In the current study, the mix group had higher ($P < 0.02$) ADFI and tended to have higher ($P < 0.08$) daily gains than the non-eater group during the initial 3 d postweaning. Overall, the performance of the mix group was mostly intermediate to that of the eater and the non-eater groups.

The mix pens had 49% eaters and 51% non-eaters (Table 7). At d 21 (weaning), eaters were 1 lb lighter ($P < 0.02$) than non-eaters. From d 21 to 24, eaters had greater (0.36 vs. 0.15 lb; $P < 0.0001$) daily gains than non-eaters. This resulted in a 62% reduction (1 to 0.37 lb) in the weight differences between eaters and non-eaters after 3 d postweaning. From d 25 to 28, there were no ($P > 0.48$) differences in daily gains between eaters and non-eaters. However, eaters continued to have greater ($P < 0.04$) daily gains than non-eaters during d 21 to 28 and d 29 to 49 and overall daily gains (d 21 to 49). For social facilitation to occur, weight gains of non-eaters in the mix pens should be either (1) closer to the weight gains of eaters in the mix pen or (2) greater than the weight gains of the non-eater group. Results showed that non-eaters in the mix pens failed both criteria. In fact, the performance of eaters and non-eaters within the mix pens were similar to the performance of separate pens of eaters and non-eaters. This suggests that social facilitation did not occur between eaters and non-eaters.

In conclusion, increasing the complexity of the creep diet improved preweaning gains when creep feed was offered 3 d preweaning. The high-complexity diet improved litter creep feed consumption and the proportion of eaters in whole litters. Eaters had lower preweaning gains, lighter weaning weights, and tended to nurse more in the middle and posterior teats compared with non-eaters. Individual creep feed consumption characteristics influenced postweaning feed intake, daily gains, weight uniformity, and reduction of postweaning lag. Social facilitation did not occur in weaned pigs housed in large commercial groups.

Table 1. Composition (as-fed basis) of the simple and complex creep diets used in Exp. 1

Ingredient, %	Simple[1]	Complex[2]
Corn	---	6.25
Milo	60.40	---
Soybean meal, 46.5% CP	31.65	2.32
Spray-dried whey	---	25.00
Fine ground oat groats	---	30.00
Extruded soy protein concentrate	---	10.00
Spray-dried animal plasma	---	6.00
Select menhaden fish meal	---	6.00
Lactose	---	5.00
Choice white grease	3.00	5.00
Monocalcium P, 21% P	1.35	0.35
Chromic oxide	1.00	1.00
Antibiotic	---	1.00
Limestone	1.35	0.40
Zinc oxide	---	0.38
Salt	0.50	0.30
L-Lysine HCl	---	0.15
DL-methionine	---	0.15
Trace mineral premix	0.15	0.15
Vitamin premix	0.25	0.25
Sow add pack	0.25	---
Acidifier	---	0.20
Phytase	0.10	---
Vitamin E, 20,000 IU	---	0.05
Total	100.00	100.00
Calculated analysis		
CP, %	19.6	23.9
SID[3] lysine, %	0.97	1.56
ME, kcal/lb	1,589	1,585
SID lysine:ME ratio, g/Mcal	2.77	4.47
Ca, %	0.87	0.79
Available P, %	0.38	0.56

[1] Diet fed in pellet form (2-mm pellets).
[2] Diet fed in meal form.
[3] Standardized ileal digestible.

Table 2. Effects of creep diet complexity on pig and litter performance[1,2]

Item	No creep	Creep diet complexity		SE	*P*-value
		Simple	Complex		
no. of litters	26	26	44	---	---
no. of pigs/litter					
d 18 (start creep)	10.8	11.0	10.3	0.3	0.30
d 21 (weaning)	10.5	10.8	10.2	0.3	0.38
Weaning age, d	21.3	21.2	21.2	0.2	0.86
Pig weights, lb					
d 0 (post-fostering)	3.44	3.37	3.48	0.13	0.70
d 18 (start creep)	12.52	12.43	12.46	0.44	0.95
d 21 (weaning)	14.20	14.04	14.22	0.46	0.74
Total gain (d 18 to 21), lb	1.67[ab]	1.59[a]	1.76[b]	0.07	0.06
Daily gain (d 18 to 21), lb	0.64[ab]	0.61[a]	0.69[b]	0.03	0.03
Litter weights, lb					
d 0 (post-fostering)	36.44	37.04	36.05	1.92	0.90
d 18 (start creep)	131.90	134.00	127.58	6.66	0.60
d 21 (weaning)	149.16	151.04	145.22	7.21	0.70
Total gain (d 18 to 21), lb	17.24	17.02	17.72	0.73	0.72
Daily gain (d 18 to 21), lb	6.66	6.57	6.90	0.31	0.58

[1] Three groups of sows (PIC, total = 96, avg. parity = 4.3 ± 0.4) were blocked according to day of farrowing and allotted to 3 treatments: no creep = litter was not provided any creep feed, simple = litter was provided a simple creep diet, and complex = litter was provided a complex creep diet. Data were analyzed with litter as the experimental unit.

[2] Creep feed with 1.0% chromic oxide was offered ad libitum from d 18 to weaning (21 d) in a rotary feeder with hopper.

[ab] Within a row, means without a common superscript differ ($P < 0.05$).

Table 3. Interactive effects of creep diet complexity and consumption category on preweaning performance of creep-fed pigs[1,2]

	Simple		Complex			*P*-value		
Item	Non-eater	Eater	Non-eater	Eater	SE	Complexity	Category	Complexity × Category
no.	203	79	145	304	---	---	---	---
Pig weight, lb								
d 0 (post-fostering)	3.37	3.35	3.46	3.44	0.13	0.62	0.63	0.87
d 18 (start creep)	12.65	11.62	13.07	12.17	0.44	0.40	<.0001	0.78
d 21 (weaning)	14.26	13.14	14.88	13.84	0.46	0.29	<.0001	0.82
Total gain, lb	1.62	1.51	1.79	1.71	0.01	0.02	0.08	0.84
Daily gain, lb	0.63	0.58	0.71	0.67	0.03	0.02	0.12	0.93

[1] Three groups of sows (PIC C29, total = 96, avg. parity = 4.3 ± 0.4) were blocked according to day of farrowing and allotted to 3 treatments: no creep = litter was not provided any creep feed, simple = litter was provided a simple creep diet, and complex = litter was provided a complex creep diet. In the simple and complex treatments, individual pigs were sampled at d 19 and 20 with fecal swabs to determine consumption category. Pigs were categorized as an eater if they showed green-colored feces in at least 1 of the 2 samplings; pigs were categorized as non-eaters when the samples were negative for green-colored feces. Data were analyzed with pig as the experimental unit.
[2] Creep feed with 1.0% chromic oxide was offered ad libitum from d 18 to weaning (21 d) in a rotary feeder with hopper.

Table 4. Effects of creep diet complexity on suckling pig performance according to weight category[1,2,3]

	Simple				Complex				
Item	Bottom	Middle	Top	SE	Bottom	Middle	Top	SE	*P*-value
no.	45	198	39	---	81	301	67	---	---
% of total	16	70	14	---	18	67	15	---	---
% eaters	47	25	23	---	83	65	62	---	---
Pig weight, lb									
d 18 (start creep)	9.04	12.43	15.83	0.22	8.09	12.94	17.44	0.20	<.0001
d 21 (weaning)	10.19	14.04	17.77	0.26	9.52	14.73	19.40	0.20	<.0001
Total gain, lb	1.14	1.61	1.95	0.08	1.43	1.79	1.97	0.07	<.0001
Daily gain, lb	0.43	0.63	0.72	0.04	0.57	0.71	0.77	0.03	0.0002

[1] Three groups of sows (PIC C29, total = 96, avg. parity = 4.3 ± 0.4) were blocked according to day of farrowing and allotted to 3 treatments: no creep = litter was not provided any creep feed, simple = litter was provided a simple creep diet, and complex = litter was provided a complex creep diet. Data were analyzed with pig as the experimental unit.
[2] Creep feed with 1.0% chromic oxide was offered ad libitum from d 18 to weaning (21 d) in a rotary feeder with hopper.
[3] Weight categories for each population: Top ≥ Least squares mean + 1 SD, Middle = Least squares mean ± 1 SD, Bottom ≤ Least squares mean - 1 SD.

Table 5. Proportion of eaters and non-eaters of creep feed according to teat location[1]

	Consumption category	
Teat location	Non-eater	Eater
no. of pigs		
Front	35	21
Middle	30	39
Rear	13	14
Percentage of pigs		
Front	62	38[a]
Middle	43	57[b]
Rear	48	52[b]

[1] Eaters of creep feed in a litter were marked; non-eaters were unmarked. Suckling bouts (n = 20 litters) were photographed within 24 h before weaning with a digital still camera to determine each individual pig's preferred teat (or pair) at d 21 of lactation. Front = teat pairs 1 and 2; middle = teat pairs 3, 4, and 5; rear = teat pairs 6 and 7.

[ab] Chi-square test: $P < 0.10$.

Table 6. Effects of creep consumption category on nursery pig performance and weight variation within pens[1,2]

	Consumption category				*P*-value		
Item	Non-eater (N)	Eater (E)	Mix (M)	SE	N vs. E	N vs. M	E vs. M
no. of pens	9	9	9	---	---	---	---
Pig weight, lb							
d 21 (weaning)	14.11	13.96	14.20	0.29	0.41	0.97	0.42
d 24	14.77	14.88	15.04	0.26	0.52	0.13	0.34
d 28	16.38	16.69	16.47	0.40	0.72	0.24	0.39
d 49	33.11	34.08	33.93	0.93	0.14	0.21	0.80
Daily gains, lb							
d 21 to 24	0.21	0.31	0.28	0.05	0.01	0.08	0.35
d 25 to 28	0.40	0.40	0.41	0.45	0.97	0.69	0.66
d 21 to 28	0.32	0.35	0.35	0.02	0.15	0.22	0.82
d 29 to 49	0.80	0.84	0.82	0.04	0.07	0.29	0.40
d 21 to 49	0.68	0.72	0.70	0.03	0.05	0.19	0.46
ADFI (d 21 to 24), lb	0.23	0.29	0.26	0.04	<.0001	0.02	0.002
F/G (d 21 to 24)	1.06	0.96	0.93	0.09	0.38	0.23	0.75
Pen CV[3], %							
d 21 (weaning)	23.8	25.1	23.5	0.8	0.26	0.78	0.16
d 24	22.3	22.5	21.3	0.9	0.83	0.42	0.29
d 28	22.9	21.8	21.2	0.9	0.40	0.19	0.63
d 49	20.7	19.5	19.6	1.0	0.40	0.43	0.96
CV[4] change, %							
d 21 to 24	-1.6	-2.5	-2.3	0.8	0.39	0.52	0.82
d 21 to 28	-0.9	-3.2	-2.3	0.8	0.06	0.26	0.43
d 21 to 49	-3.0	-5.6	-3.1	0.8	0.03	0.96	0.02

[1] A total of 675 pigs (PIC C29 × 327, initial BW 14.2 lb and 21.2 ± 0.2 d of age) were used with 25 pigs per pen and 9 replications per treatment. Group composition: non-eater = non-creep fed pigs and non-eaters of creep feed, creep = eaters of creep feed, and mix = 51% non-eaters and 49% eaters. Data were analyzed with pen as the experimental unit.

[2] All treatments were fed a budget of 1 and 2 lb/pig of a commercial SEW and transition diet, respectively.

[3] Coefficient of variation within pen.

[4] Difference in pen CV between two time points: final %CV - initial %CV.

Table 7. Postweaning growth performance of non-eater and eater pigs within mix pens (50% non-eaters:50% eaters)[1,2]

	Consumption category			
Item	Non-eater	Eater	SE	*P*-value
no.	113	108	---	---
% of total	51	49	---	---
Pig weights, lb				
d 21	14.81	13.82	0.31	0.02
d 24	15.26	14.88	0.31	0.38
d 28	17.04	16.58	0.33	0.35
d 49	33.42	34.02	0.82	0.54
Daily gains, lb				
d 21 to 24	0.15	0.36	0.04	<.0001
d 25 to 28	0.45	0.42	0.03	0.48
d 21 to 28	0.32	0.39	0.02	0.002
d 29 to 49	0.78	0.83	0.03	0.04
d 21 to 49	0.67	0.72	0.03	0.007

[1] A total of 675 pigs (PIC C29 × 327, initial BW 14.2 lb and 21.2 ± 0.2 d of age) were used with 25 pigs per pen and 9 replications per treatment. Group composition: non-eater = non-creep fed pigs and non-eaters of creep feed, creep = eaters of creep feed, and mix = 51% non-eaters and 49% eaters. In the mix treatment, differences between non-eater and eater pigs were analyzed with pen as the block and pig as the experimental unit.
[2] Pigs were fed a budget of 1 and 2 lb/pig of a commercial SEW and transition diet, respectively.

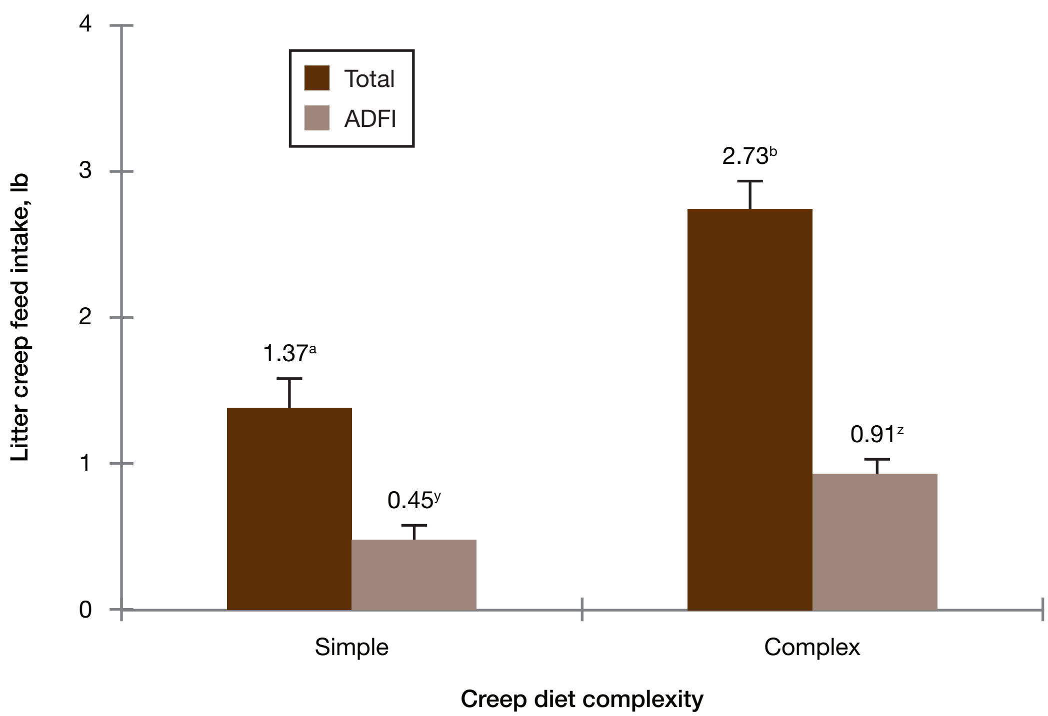

Figure 1. Total and daily creep feed intake of litters (mean ± SE) fed either simple or complex creep diets.
[ab]$P < .0006$; [yz]$P < .0006$.

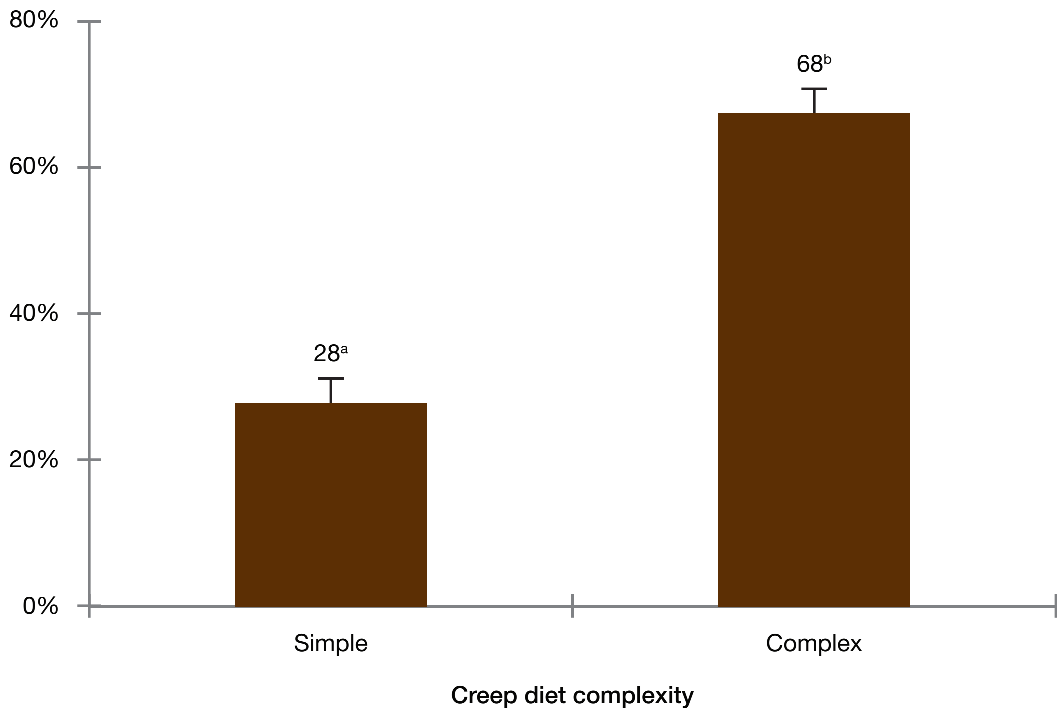

Figure 2. Effect of creep diet complexity on the proportion (mean percent ± SE) of eaters in whole litters.
[ab]*P* < .0001.

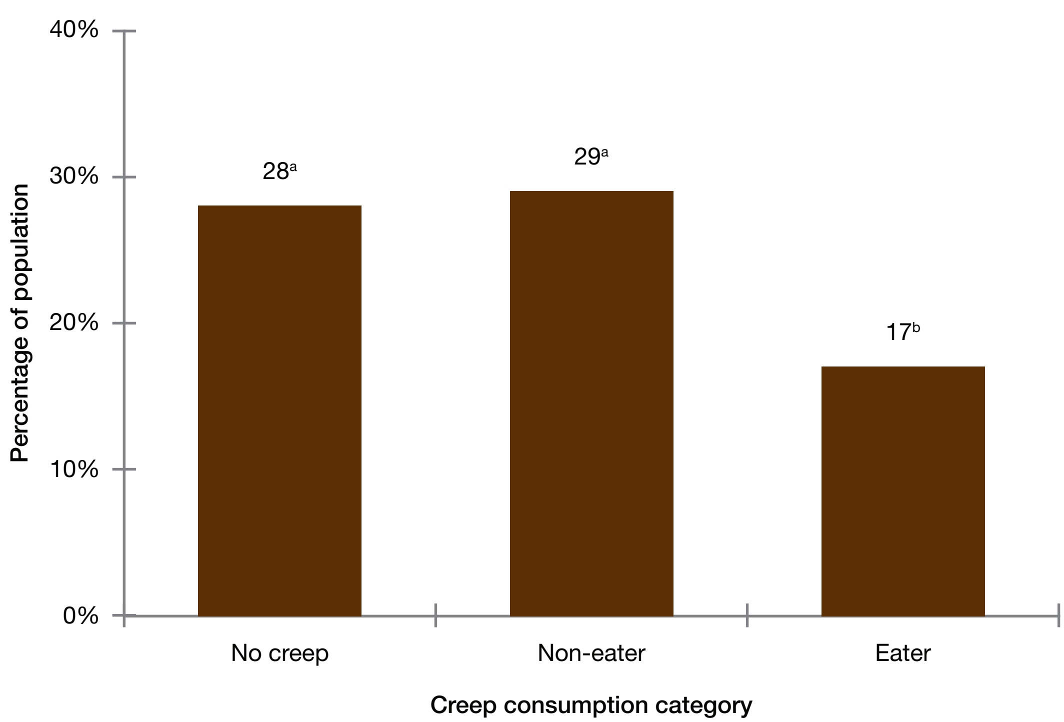

Figure 3. Percentage of fall back pigs during the initial 3 d postweaning within each creep consumption category.
Fall back pigs were those that did not gain weight or lost weight in the first 3 d postweaning. No creep = pigs that were not provided creep feed preweaning, non-eater = pigs that were negative for creep feed consumption, and eater = pigs that positively consumed creep feed. χ^2 = 18.0; Category effect, [ab]*P* < .0001.