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EFFECTS OF DIFFERENT CREEP FEEDER DESIGNS AND FEED ACCESSIBILITY ON CREEP FEED CONSUMPTION AND LITTER PERFORMANCE[1]

R. C. Sulabo, M. D. Tokach, E. J. Wiedemann, J. L. Nelssen, S. S. Dritz[2], R. D. Goodband, and J. M. DeRouchey

Summary

The objective of this experiment was to determine the effects of different creep feeder designs and increased feed accessibility on creep feed consumption and pre-weaning performance. A total of 54 sows (PIC Line 1050) and their litters were used in this study. Two groups of sows were blocked according to parity and date of farrowing using a randomized complete block design and allotted to three experimental treatments: Treatment 1 – rotary feeder with hopper (Control), Treatment 2 – rotary feeder without hopper, and Treatment 3 – pan feeder. A creep diet (1,585 kcal ME/lb, 1.56% TID Lys) with 1.0% chromium oxide was offered *ad libitum* at d 18 until weaning (d 21). A single lactation diet (1,586 kcal ME/lb, 0.97% TID Lys) was used, where sows were allowed free access to feed throughout lactation. Piglets were weighed individually at d 0 (birth), 18, and 21 (weaning) to calculate total and daily gains. Litter creep feed intake as feed disappearance was also calculated. Fecal samples from all piglets were taken twice using sterile swabs between 3 and 12 h before weaning for all treatments. Piglets were categorized as 'eaters' when the fecal sample was colored green at least once on any of the two samplings. Results showed no differences in pig (P<0.18) and litter (P<0.51) weights at weaning among litters using the different types of creep feeder. Total and daily gains of pigs (P<0.20) and litters (P<0.31) were also similar across treatments. Litters using the rotary feeder without the hopper or the pan feeder had 2.7 times greater (P<0.0001) total creep disappearance than those using the rotary feeder with the hopper. The average feeding frequency was 1, 2.3, and 4.2 times per 12 h for the rotary feeder with and without the hopper, and the pan feeder, respectively. Creep feeder design influenced (P<0.0001) the proportion of eaters created among piglets provided with creep feed. There were 69, 47, and 42% eaters in creep-fed litters using the rotary feeder with a hopper, rotary feeder without hopper, and pan feeder, respectively. In conclusion, the proportion of eaters in creep-fed litters can be influenced by non-dietary factors, such as creep feeder design.

(Key words: feed management, creep feed, feeder design.)

Introduction

Previous studies have shown that suckling piglets categorized as eaters have higher intakes and better growth performance immediately post-weaning than non-eaters of creep feed. If creep feeding behavior can be encouraged and more eaters can be created within a litter, then post-weaning performance can be improved. Very few studies have evaluated the effect of different creep feeder designs and

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[2]Food Animal Health and Management Center, College of Veterinary Medicine.

creep feed accessibility on feeding behavior, intake, and performance of suckling piglets. Some of these studies have shown positive improvements on feeder visiting time and intakes of suckling pigs by using a familiar trough or when feeding space was increased. However, these studies evaluated whole litters and did not differentiate between eaters and non-eaters within a litter. Moreover, the effects of different types of creep feeders on creating eaters have never been evaluated. Therefore, the objective of this experiment was to determine the effects of different creep feeder designs and increasing creep feed accessibility on the rate of creating piglet eaters and pre-weaning performance.

Procedures

A total of 54 sows (PIC Line 1050) and their litters were used in this study conducted at the Kansas State University Swine Research and Teaching Center farrowing facility. Sows used in this experiment were from two batches of sows farrowed in June and July 2007, with 27 experimental sows included from each batch. Sows were blocked according to parity and date of farrowing and were allotted to three experimental treatments using a randomized complete block design. Cross-fostering was performed within 48 h post-farrowing to standardize litter weights and litter size (>10 pigs). The sow or litter was the experimental unit with 18 replicates per treatment group.

There were three types of creep feeder designs tested in this study. Treatment 1 used a rotary creep feeder (Rotecna® Mini Hopper Pan, Rotecna SA, Spain), which is 10.6 inches in diameter, 34 inches in linear feeding space, and 2.1 inches deep (Figure 1). It is designed to accommodate 5 pigs per feeding time. This feeder design is equipped with a 6-liter capacity hopper, which is adjustable to five different settings of feeder gaps to allow *ad libitum* feeding. The hopper also has a curved rim and wings that helps separate piglets while feeding and to minimize feed wastage. The feeder can also be latched to the flooring of the pen and fixed on a specific location within the farrowing crate. This feeder was used in our previous creep feeding studies, and, therefore, served as the control treatment in this study. In past studies, 70% of piglets were categorized as eaters using this feeder. For Treatment 2, a rotary creep feeder without a hopper (Rotecna® Mini Pan, Rotecna SA, Spain) was used (Figure 2). This feeder design has the same dimensions as the feeder in Treatment 1, and can also be latched on a specific location within the farrowing crate. This feeder represents conventional bowl feeders that are commonly used in the industry. For Treatment 3, a stainless pan feeder was used (Figure 3). This feeder is 40.2 inches long, 5.3 inches wide, and 1 inch deep. The feeder is placed in between the divider of two farrowing crates, which provides two feeding troughs per feeder with a 1.1 inch width per trough. The rotary creep feeder (Treatment 1 and 2) was placed in a location where it was most accessible to piglets, sows could not urinate or defecate in it, or the side opposite of the udder area of the sow. This was chosen to ensure creep feed accessibility, prevent soiling of the creep feed, and allow unhindered suckling of piglets to the sow.

A creep diet (1,585 kcal ME/lb, 1.56% TID Lys) with 1.0% chromium oxide was offered *ad libitum* at d 18 until weaning on d 21 (Table 1). The creep diet was in pellet form (2-mm pellets). For Treatment 1, sufficient amounts of creep feed were placed in the hopper to ensure that feed was always available. The adjustment of the hopper was checked daily to allow *ad libitum* feeding and control feed wastage. For Treatments 2 and 3, small amounts of creep feed were placed on the feeder whenever the feeder was empty. The feeders were checked every 2 h for 12 h each day. In every crate, the daily frequency of adding creep feed was recorded. A single lactation diet (1,586 kcal ME/lb, 0.97% TID Lys) was used in the experiment. Sows were allowed free access to feed throughout lactation.

Water was made available at all times for both sows and their litters using nipple drinkers and bowls, respectively.

Piglets were weighed individually at d 0 (birth), 18, and 21 (weaning). The amount of creep feed offered was weighed daily. Creep feed that was not consumed at the time of weighing were collected using a Mini Shop-Vac® and weighed back. Fecal samples from all piglets were taken using sterile swabs twice between 3 and 12 h before weaning for all treatments. The color of each fecal sample was visually determined. Piglets that tested negative on the first fecal sampling were re-sampled 9 to 12 h after the first sampling. Piglets were categorized as 'eaters' when the fecal sample was colored green at least once on any of the two samplings.

Sows were weighed post-farrowing and at weaning. Weekly feed intake of the sows was recorded to calculate total and average daily feed intake. General health of the 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 using heat lamps when needed.

Periodic and cumulative average daily gain and creep feed intake as feed disappearance were calculated for each treatment group. Data were analyzed as a randomized complete block design using PROC MIXED of SAS. The effect of different creep feeder designs on percentage of eaters was analyzed using the Chi-square test in SAS.

Results and Discussion

The technical parameters and performance of lactating sows used in this study is shown in Table 2. Experimental sows had an average parity of 2.1 ± 0.2 and lactation length of 21.1 ± 0.3 d. There were no differences in post-farrowing weight (P<0.90), weaning weight (P<0.90), and lactation weight loss (P<0.56) among the treatments. Total and average daily feed intake of sows throughout lactation was also similar (P<0.30) among the treatments.

The effect of different creep feeder designs on pig and litter performance is shown in Table 3. There were no differences in pig (P<0.18) and litter (P<0.51) weights at weaning among litters using the different types of creep feeder. Total and daily gains of pig (P<0.20) and litters (P<0.31) were also similar across treatments. However, litters using the rotary feeder without the hopper or the pan feeder had 2.7 times greater (P<0.0001) total creep disappearance than those using the rotary feeder with the hopper. (Figure 4).

The lack of differences in pig and litter growth rates among the treatments suggest that a large proportion of creep feed offered to litters using the rotary feeder without the hopper and the pan feeder were not consumed but wasted. The design of these two feeders is more open and creep feed is more accessible to piglets compared to the feeder with the hopper. However, these feeders also allowed some piglets to root, lie in, and push feed out of the feeder, which eventually reduced the availability and accessibility of creep feed to other piglets. The higher creep feed disappearance with the pan feeder also confirmed results of other studies where increased access to creep feed was provided. The pan feeder in this study was designed to provide more feeding spaces than the rotary feeder, but piglets more often approach and consume creep feed with their bodies parallel to the feeder rather than pigs eating side by side (Figure 3).

The addition of the hopper to the rotary feeder reduced total creep disappearance without affecting growth performance. This feeder design was used in our previous creep feeding trials and was shown to measure none to very small amounts of creep intake for whole litters, indicating its ability to control feed wastage. It can be assumed that the total creep disappearance measured in this study with this feeder is close to the true intake of creep feed by the litter. There are aspects of the design of this feeder that may help explain the lower creep disappearance. The conical shape as well as the curved rim and wings at the bottom of the hopper prevented piglets from rooting, standing over, or pushing creep feed out of the troughs. The hopper was also adjusted daily to manage the amount of feed that flowed out of the gap, which controlled the level of feed in the trough.

The average feeding frequency was 1, 2, 3, and 4.2 times per 12 h for the rotary feeder with and without the hopper, and the pan feeder, respectively. Though the rotary feeder with hopper allowed *ad libitum* feeding, the daily weighing and re-introduction of the feeder to the litter was counted as one feeding per day. The higher feeding frequency for both the rotary feeder without the hopper and the pan feeder were facilitated to minimize feed wastage. In creep feeding, the typical recommendation is to feed small amounts frequently to stimulate intake and manage feed wastage. However, the practice still allowed higher creep disappearance than the feeder with the hopper. This also demonstrated the extra effort needed to manage these creep feeders, which in the end, did not provide any positive returns.

In terms of creating eaters, the type of creep feeder influenced (P<0.0001) the proportion of eaters created among piglets provided with creep feed (Figure 5). In litters using the rotary feeder with the hopper, 69 and 31% of suckling piglets were categorized as eaters and non-eaters at weaning, respectively. These proportions were consistent with our previous creep feeding studies using the same feeder and creep diet. On the other hand, litters on the rotary feeder without the hopper had 22% fewer eaters (P<0.0001) than with litters on the rotary feeder with the hopper. Likewise, litters using the pan feeder had 27% less eaters (P<0.0001) than litters on the rotary feeder with the hopper.

The higher proportion of eaters created using the rotary feeder with the hopper may be a function of both feeder design and piglet creep consumption. The addition of the hopper to the rotary feeder significantly increased the percentage of eaters, which may be partially attributed to its design. This feeder design staves off piglets from wasting feed and provides continuous availability of feed in the troughs. In a recent study evaluating Cr_2O_3 as a marker for identifying creep feed-eating piglets, eaters were identified as piglets consuming Cr_2O_3-containing creep feed in appreciable amounts or in multiple days. Therefore, this feeder enabled more piglets in the litter to consume significant amounts of creep feed. This finding further supports the assumption that creep feed disappearance using this feeder is close to the true value of litter creep intake.

The lower proportion of eaters generated from litters using the rotary feeder without the hopper and the pan feeder also supports the notion that more creep feed was wasted than consumed. Greater accessibility and increased feeding spaces resulted to higher creep disappearance, but did not produce more eaters within the litter. This is contrary to the assumption of previous studies, where increased feeding space and accessibility was thought to encourage more piglets to imitate others at the feeder and stimulate initial intake of creep feed. The fewer number of eaters in this study suggest that less creep feed was available in these feeders for piglets to consume in appreciable amounts. Moreover, the rate of feed wastage due to physical activity of piglets on the feeder may be faster than their rate of consumption.

In conclusion, the type of creep feeder may influence the proportion of eaters in creep-fed litters. Increasing feeding space and feed accessibility led to higher feed disappearance, but did not necessarily generate more eaters in whole litters. The rotary feeder with the hopper achieved a lower creep feed disappearance, but created the most eaters. Thus, the proper choice of creep feeder is essential to manage creep feeding and to maximize the number of eaters in the litter.

Figure 1. Rotary Feeder With Hopper (Control).

Figure 2. Rotary Feeder Without Hopper.

Figure 3. Pan Feeder.

Table 1. Diet Composition (as-fed basis)

Ingredient, %	Creep[a]	Lactation[b]
Corn	6.15	60.00
Soybean meal (46.5% CP)	2.32	31.20
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	5.00	5.00
Monocalcium P (21% P)	0.35	1.45
Chromium oxide	1.00	-
Antibiotic	1.00	
Limestone	0.45	1.20
Zinc oxide	0.38	-
Salt	0.30	0.50
L-Lysine HCl	0.15	-
DL-methionine	0.15	-
Trace mineral premix	0.15	0.15
Vitamin premix	0.15	0.25
Sow add pack	-	0.25
Acidifier	0.20	-
Flavor	0.05	-
Vitamin E, 20,000 IU	0.05	-
Total	100.00	100.00
Calculated analysis		
Crude protein, %	23.9	19.6
TID Lysine, %	1.56	0.97
ME, kcal/lb	1,585	1,589
Calcium, %	0.79	0.87
Available P, %	0.56	0.38
TID Lysine:ME ratio, g/Mcal	4.47	2.77

[a]Diet fed in pellet form.
[b]Diet fed in meal form throughout lactation.

Table 2. Sow Technical Parameters[ab]

Treatment	Feeder Design			SED	Probability, *P*<
	Rotary feeder with hopper	Rotary feeder without hopper	Pan feeder		
No. of litters	18	18	18	-	-
No. of pigs	189	188	185	-	-
Average parity	2.1	2.2	2.0	0.13	0.23
Lactation length, d	21.1	21.2	21.2	0.17	0.60
Sow weight, lb					
Post-farrowing	504	511	503	19.1	0.90
Weaning	478	485	484	17.2	0.90
Change	-26	-26	-19	5.6	0.56
Lactation feed intake, lb					
Total	227.4	232	246.5	12.6	0.30
ADFI	11.3	11.5	12.2	0.64	0.35

[a]Two groups of sows (total =54, PIC Line 1050) were blocked according to day of farrowing and parity and allotted to the three treatments.
[b]Creep feed with 1.0% chromium oxide was offered *ad libitum* from d 18 to weaning (20 d).

Table 3. Effects of Different Creep Feeder Designs on Pig and Litter Performance[ab]

Treatment	Feeder Design			SED	Probability, *P*<
	Rotary feeder with hopper	Rotary feeder without hopper	Pan feeder		
No. of litters	18	18	18	-	-
No. of pigs/litter					
D 18 (start creep)	10.5	10.4	10.3	0.27	0.70
D 21 (weaning)	10.5	10.4	10.3	0.27	0.70
Pig weights, lb					
Post-fostering	3.0	3.0	3.0	0.06	0.96
D 18 (start creep)	10.8	11.3	11.4	0.37	0.21
D 21 (weaning)	12.4	13.1	13.1	0.43	0.18
Total gain (d 18 to 21), lb	1.6	1.8	1.7	0.09	0.20
Daily gain (d 18 to 21), lb	0.54	0.59	0.58	0.03	0.20
Litter weights, lb					
Post-fostering	31.6	31.4	31.0	0.69	0.66
D 18 (start creep)	113.4	117.6	117.3	4.48	0.58
D 21 (weaning)	130.3	135.9	135.2	5.23	0.51
Total gain (d 18 to 21), lb	16.9	18.4	17.9	1.0	0.31
Daily gain (d 18 to 21), lb	5.64	6.12	5.96	0.32	0.31

[a]Two groups of sows (total =54, PIC Line 1050) were blocked according to day of farrowing and parity and allotted to the three treatments.
[b]Creep feed with 1.0% chromium oxide was offered *ad libitum* from d 18 to weaning (20 d).

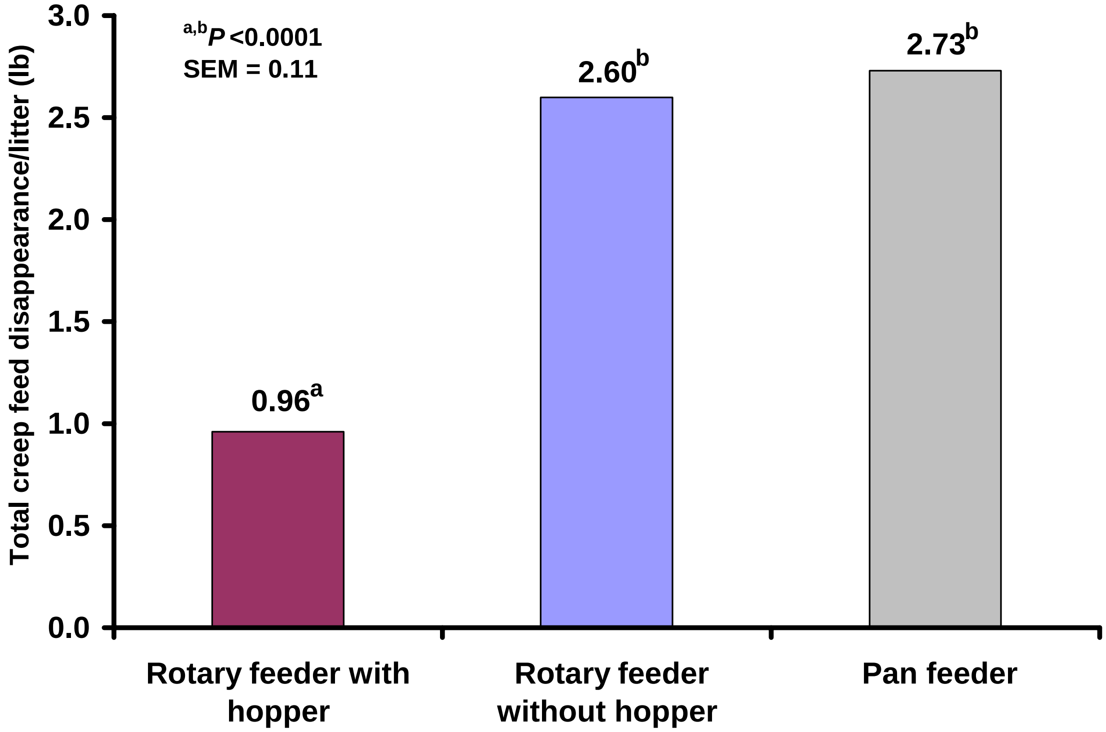

Figure 4. Total Creep Feed Disappearance Between Different Creep Feeder Designs.

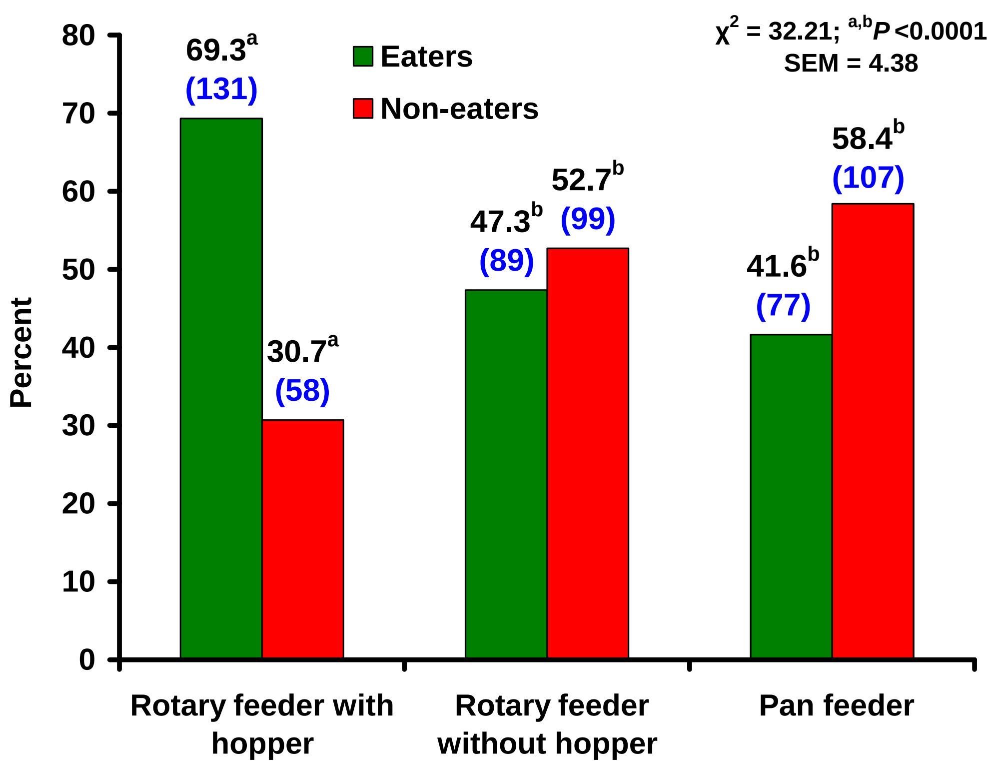

Figure 5. Effect of Creep Feeder Design on Creating Eaters (number of pigs in parentheses).