2006

Impact of Repeated Out-Of-Feed Events and Fineness of Grind on Grow-Finish Performance

Mike Brumm
University of Nebraska, mbrumm1@unl.edu

Sheryl Colgan
University of Nebraska

Impact of Repeated Out-Of-Feed Events and Fineness of Grind on Grow-Finish Performance

Michael C. Brumm
Sheryl L. Colgan[1]

Summary and Implications

Out-of-feed events are a growing problem in nursery and grow-finish facilities due to issues associated with feed delivery to bulk bins and bridging of feed in bulk bins. Reports of bridging are increasing as producers continue to reduce the fineness of grind for complete diets in order to improve feed conversion. A study was conducted to examine the effect of repeated out-of-feed events and diet particle size on barrow performance in a wean-to-finish facility beginning six weeks after weaning. Corn-soybean meal based diets were either coarse (1,266 microns) or medium ground (1,019 microns) for the duration of the experiment. Within particle size, pigs were never out-of-feed or denied access to feed for a 20-hour period beginning at noon on a random day each week for 16 weeks. For the first eight weeks, weekly out-of-feed events reduced daily gain 0.15 lb/day compared to the never out-of-feed treatment (P<0.001) due to a reduction in daily feed intake (P=0.003) with no effect on feed conversion efficiency. There was no effect of out-of-feed events on daily gain or feed conversion for the second eight week period of the experiment. For the 109-day trial period, weekly random 20-hour out-of-feed events resulted in a 0.077 lb/day decrease in daily gain with no effect on feed conversion. The 247 micron reduction in average diet particle size resulted in a 0.091 lb/lb improvement in overall feed conversion (P=0.001) for the coarse versus medium ground diets. There was no effect of any experimental treatment on skin lesion scores, a measure of pig welfare and injury from fighting at the feeder. There was no interaction of out-of-feed events and diet particle size. These results suggest that out-of-feed events can have major consequences for pig performance. However, pigs appear to adjust to weekly out-of-feed events, even when they occurred on a random day within each week. The penalty for repeated out-of-feed events is a reduction in daily gain, with no impact on feed conversion, while the penalty for coarser ground diets is a worsening in feed conversion, with no change in daily gain.

Introduction

In theory, bulk bins and automated feed delivery systems assure an uninterrupted flow of feed to feeders in swine grow-finish facilities. In practice, growing-finishing pigs have varying disruptions in feed availability, some of which may have very serious consequences. While every swine grow-finish facility has occasional disruptions due to mechanical failures in the feed delivery system, there are additional disruptions due to human errors associated with delivering feed to the bulk bin and feed bridging associated with feed removal from the bin. Out-of-feed events are a known cause of ulcers in pigs and are suspected of being associated with increased incidence of hemorrhagic bowel syndrome and ileitis. It has been speculated that each 20 to 24 hour out-of-feed event results in an increase in variation in growth within a population of pigs and results in a reduction in daily gain.

Pork producers routinely mill ingredients in swine diets to have a particle size of 700 to 900 microns, because the finer particle size results in better feed conversion efficiency. Recent results from Kansas State University suggest that as particle size decreases, and the amount of fat added increases in corn-based diets, the angle of repose (an estimate of likelihood of bridging) increases. Data suggest a 1-1.5% improvement in feed conversion efficiency for each 100 micron reduction in particle size from 1000 to 500 microns. The current University of Nebraska recommendation is to process complete diets to an average particle size of 650 to 750 microns for all grains except wheat.

The following experiment was designed to examine the interaction of fineness of grind and random out-of-feed events on pig performance and welfare.

Materials and Methods

The research was conducted at the University of Nebraska's Haskell Ag Lab at Concord. The research facility was a fully slatted, naturally ventilated wean-to-finish unit with 16 pens (8 ft x 14 ft). Each pen had one, two-hole Farmweld wean-to-finish feeder and one Drik-o-Mat wean-to-finish cup drinker. There were 15 pigs per pen at weaning (7.5 ft^2/pig) and

(Continued on next page)

pen size was not reduced in the event of pig death or removal.

On the day of weaning (14-21 days of age), the pigs were transported approximately 200 miles. At arrival, they were ear tagged, individually weighed and assigned to pens on the basis of arrival weight such that all pens had similar mean weights and within pen coefficients of variation for weight. The experimental treatments began six weeks after weaning. There were four pens of pigs per experimental treatment combination. Only barrows were used in this experiment to minimize the random out-of-feed events associated with gilts urinating in a feed trough and plugging a feeder for an unknown length of time.

The experimental treatments, in a 2 x 2 factorial arrangement, were:

1. Out-of-feed, never or weekly,
2. Feed particle size, coarse or medium.

The out-of-feed events consisted of closing the feeder delivery device completely at noon and reopening the device at 8:00 the following morning which resulted in a 20-hour period when no feed was available to a pen of pigs. The day of the week that the out-of-feed event began was randomly selected each week from Monday through Friday. Pigs were weighed every other week, and on the week of weighing, the feeders were never closed on Thursday evening so that pig weights on Friday morning were not confounded with an out-of-feed event.

Corn-soybean meal based diets were formulated with corn ground in a full-screen hammer mill with two different screen sizes. Feed samples were collected every other Friday, stored, and submitted for particle size analysis at the conclusion of the experiment.

Diets containing 40 g/ton tylosin were switched to the next lysine sequence on the basis of the average weight of all pigs in the facility. Lysine levels were 1.15% from 45-80 lb, 0.99% from 80-135, 0.77% from 130 to 195, and 0.62% from 195 to slaughter. Diets contained 3% added fat from 45 to 135 lb body weight and 1.5% added fat thereafter.

Skin lesions (i.e. lesions that were pink/bleeding), tail biting, and lameness were observed on every weigh day and independently scored by two observers. Lesions were ranked on a 0 to 4 scale with 0 being no fresh lesions observed and 4 being many (12+ small or 6+ large) lesions. Tail biting was ranked on a 0 to 4 scale with 0 being no tail biting and 4 being a large, deep and open wound.

Pigs were vaccinated for erysipelas, M. hyo and ileitis prior to the start of the out-of-feed events. All pigs that died were examined by a veterinarian for cause of death. Prior to the out-of-feed events, pigs were diagnosed with Strep suis and gut edema, most likely caused by a beta-hemolytic *E. coli*.

All pigs that weighed greater than 205 lb were slaughtered at Tyson Foods in Madison, Neb., four days after final weights were taken. Pigs were tattooed by pen, and pen average carcass data for back fat, loin muscle depth and percent lean was provided by Tyson Foods.

The pen of pigs was the experimental unit for all observations.

Results and Discussion

The only interactions ($P<0.1$) between feed particle size and out-of-feed events was starting weight and carcass lean percent. Thus, the main effects of the experimental treatments on pig performance are presented in Table 1.

Random, weekly 20-hour out-of-feed events resulted in a 0.077 lb/day reduction in daily gain ($P=0.008$) compared to pigs that were never out-of-feed. Weekly out-of-feed events reduced daily feed overall 0.195 lb/day ($P<0.023$) but had no effect on feed conversion.

The pigs adapted to the random weekly out-of-feed event. For the first 53 days of the experiment, daily gain was reduced 0.150 lb/day compared to 0.009 lb/day for the subsequent 56-day period for the out-of-feed versus never pigs. Similarly, daily feed was reduced 0.291 lb/day for the first 53-day period and only 0.101 lb/day for the subsequent period. There was no difference in feed conversion between the out-of-feed and never treatments for either period. Figures 1 and 2 document the declining impact of the out-of-feed events on daily gain and daily feed intake as the trial progressed.

Because of the overall reduction in daily gain, out-of-feed pigs were lighter at slaughter, had lower hot carcass weights, carcass fat depth and carcass loin depth compared to the never pigs. There was no effect of out-of-feed events on carcass lean percent.

Particle size for the medium treatment was coarser than expected, even though ground corn was pre-sampled at the commercial mill for both particle sizes with the intent of having coarse and fine particle size diets. Particle size for the coarse diet averaged 1,266 microns (2.16 SD) and that for the medium diet averaged 1,019 microns (1.61 SD) for the entire trial. However, for the first eight weeks, particle size for the coarse and medium diets was 1,224 microns (2.4 SD) and 929 microns (1.7 SD). For the second eight-week period, the corresponding particle sizes were 1,307 microns (1.9 SD) for the medium diet and 1,109 microns (1.6 SD) for the coarse diet.

The response to differences in diet particle size agrees with previously published results. There was no effect of particle size on daily gain. However, pigs fed the coarse diets ate more feed for the final 56-

Table 1. Impact of experimental treatments on pig performance.

	Out of feed[a]		Particle size[b]			P values		
Item	Never	Weekly	Coarse	Medium	SE	OOF	PS	OOF x PS
No. pens	8	8	8	8				
Pig wt, lb								
On test	53.2	51.3	52.3	52.2	0.7	0.074	0.941	0.031
Day 53	155.2	145.3	150.9	149.6	1.7	0.001	0.613	0.197
Day 109	261.8	251.5	257.6	255.7	2.3	0.007	0.559	0.274
Coefficient of variation of pig weight within pen, %								
On test	17.4	16.1	16.3	17.3	1.6	0.891	0.099	0.301
Day 53	10.7	10.9	10.3	11.3	1.0	0.881	0.513	0.997
Day 109	8.1	8.2	7.5	8.8	0.7	0.881	0.230	0.475
Daily gain, lb								
On test - day 53	1.924	1.774	1.860	1.838	0.022	<0.001	0.482	0.638
Day 53 - day 109	1.903	1.894	1.905	1.891	0.019	0.746	0.612	0.246
Overall	1.913	1.836	1.883	1.866	0.017	0.008	0.515	0.651
Daily feed, lb								
On test - day 53	4.421	4.130	4.344	4.208	0.056	0.003	0.113	0.552
Day 53 - day 109	6.566	6.465	6.674	6.358	0.058	0.240	0.002	0.525
Overall	5.524	5.329	5.541	5.311	0.053	0.023	0.010	0.497
Feed:gain								
On test - day 53	2.298	2.328	2.335	2.290	0.013	0.133	0.032	0.601
Day 53 - day 109	3.448	3.413	3.501	3.359	0.022	0.291	0.001	0.700
Overall	2.888	2.901	2.940	2.849	0.016	0.545	0.001	0.612
Carcass data, Tyson Fresh Meats, Madison, Neb.								
Carcass wt, lb	206.3	197.5	201.6	202.1	1.7	0.004	0.839	0.173
Fat depth, in	1.02	0.97	0.98	1.00	0.02	0.146	0.518	0.114
Loin depth, in	2.75	2.67	2.72	2.70	0.02	0.023	0.553	0.306
Lean, %	53.5	53.5	53.6	53.4	0.1	1.000	0.257	0.021
Pigs dead, no.[c]	2	4	2	4				
removed, no.	1	1	0	2				
< 205 lb, no.	2	4	2	4				

[a]Never = never out-of-feed; Weekly = 20 hour out-of feed on a random day each week.
[b]Coarse = average 1,266 microns; Medium = average 1,019 microns.
[c]Chi Square analysis; P > 0.1 for all comparisons.

day period compared to pigs fed the medium ground diets. Pigs fed the coarse diets had poorer feed conversion efficiencies for both the 53-day initial and 56-day final period. This resulted in a 0.091 lb of feed per lb of gain improvement in overall feed conversion efficiency for the pigs fed the medium versus coarse diet (P<0.001), an improvement of 3.1%.

Feed was delivered in bulk for this experiment and augered into a weigh cart for delivery to individual feeders. While not quantified, there were considerably fewer bridging problems with feed removal from the bulk storage bins for the coarse versus medium diets.

Because of the small numbers involved, it was not possible to detect a significant difference between treatments for the number of pigs that died, were removed or weighed less than or equal to 205 lbs at the end of the experiment. However, pigs fed the medium diets and pigs experiencing weekly random out-of-feed events had numerically higher numbers of deaths and lightweight pigs at the end of the experiment. Two pigs were removed from the experiment for severe tail biting injury with one on the medium/out-of-feed treatment combination and the other on the medium/never out-of-feed treatment combination.

There was no effect (P > 0.1) of any experimental treatment on skin lesions scores (Table 2). There was also no effect (P > 0.1) of out-of-feed events on tail biting. However, pigs fed the medium diet had an increase in severity of tail biting score compared to the coarse pigs (P=0.012).

(Continued on next page)

Conclusion

Weekly, random 20-hour out-of-feed events reduced overall gain at the end of a 109-day grow-finish trial 11.3 pounds. With 16 out-of-feed events, this amounted to a 0.7 lb decrease in gain for each out-of-feed event overall. However, the main impact of out-of-feed events occurred in the first eight weeks, when daily gain was reduced 0.15 lb/day for a total gain depression of 7.9 lb for pigs experiencing weekly, random out-of-feed events. There was no effect of out-of-feed events on feed conversion efficiency, nor was there any interaction between out-of-feed events and feed particle size. As expected, pigs fed the medium ground diets had no difference in daily gain, but had a 3.1% improvement in feed conversion efficiency compared to pigs fed the coarsely ground diets. In production units that must sell pigs by a certain date, these data will allow producers to examine whether the improvement in feed conversion efficiency from finely ground diets overcomes the loss in weight gain from out-of-feed events that may be due to increased bridging of finely ground diets.

[1]Michael C. Brumm is a professor of animal science and extension swine specialist, and Sheryl L. Colgan is a research technologist at the Northeast Research and Extension Center in Concord, Neb. This research was financially supported by a grant from the Nebraska Pork Producers Association through the National Pork Board.

Table 2. Impact of experimental treatments on skin lesions and tail biting score (0 to 4 scale).

	Out of feed[a]		Particle size[b]		P value[c]	
Item	Never	Weekly	Coarse	Medium	OOF	PS
Average skin lesions score	0.29	0.26	0.27	0.27	0.351	0.808
Average tail biting score	0.03	0.02	0.01	0.05	0.301	0.012

[a]Never = never out-of-feed; Weekly = 20 hour out-of feed on a random day each week.
[b]Coarse = average 1,266 microns; Medium = average 1,019 microns.
[c]Friedman Chi Squared test on ranked pen means.

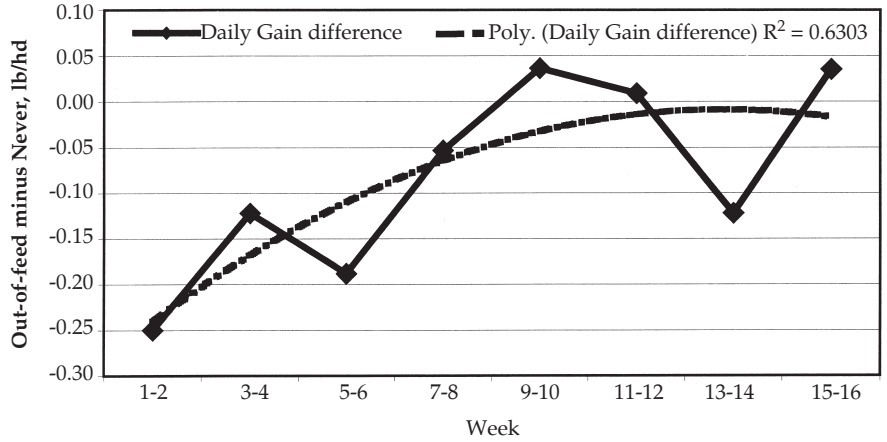

Figure 1. Reduction in daily gain by two-week period for the out-of-feed treatment versus the never out-of-feed treatment.

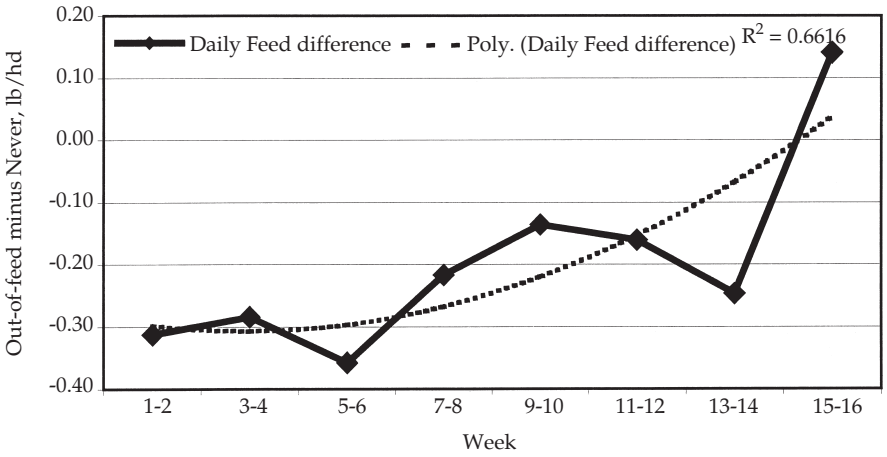

Figure 2. Reduction in daily feed by two-week period for the out-of-feed treatment versus the never out-of-feed treatment.