Effects of Meal or Pellet Diet Form on Finishing Pig Performance and Carcass Characteristics[1]

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Summary
Two experiments were performed to determine the effects of feeding diets in meal or pellet form on finishing pig performance. A corn-soybean meal-based diet was fed in Exp. 1, and a diet containing alternative ingredients was used in Exp. 2. All pelleted diets were processed through a CPM pellet mill (California Pellet Mill Co., Crawfordsville, IN) equipped with a 3⁄16 in. die.

In Exp. 1, a total of 1,072 pigs (60.7 lb) were used in a 112-d trial. Treatments were arranged in 2 × 2 factorial design (10 pens per treatment) with main effects of diet form (meal or pellet) and gender (barrows or gilts). Diet formulation and particle size (approximately 660 microns) was identical among the treatments. From d 0 to 112, pigs fed pelleted diets had increased ADG (2.04 vs. 1.92 lb, $P < 0.01$) compared with pigs fed diets in meal form. There was no difference ($P = 0.69$) in ADFI, but pigs fed pelleted diets had a 5.3% improvement (2.68 vs. 2.83, $P < 0.01$) in F/G compared with pigs fed meal diets. With the improvements in F/G driving the growth response, pigs fed pellets were 13.6 lb heavier ($P < 0.01$) at off test than pigs fed meal diets.

In Exp. 2, a total of 1,214 pigs (58.3 lb) were used in a 42-d trial to evaluate diets containing alternative ingredients in pellet or meal form. Barrow and gilt pens were randomly allotted to a meal or pellet treatment group (11 pens per treatment). Like Exp. 1, diet particle size (approximately 660 microns) and formulation were identical among the treatments. Pigs fed a by-product-based diet in pellet form had greater (2.05 vs. 1.95 lb, $P < 0.01$) ADG than pigs fed the identical diet in meal form. There were no differences ($P \geq 0.15$) in overall (d 0 to 42) ADFI or F/G between pigs fed meal and pelleted diets. Pigs fed pelleted diets had a numerical ($P = 0.14$) weight advantage of 4.1 lb on d 42 compared with pigs fed meal diets.

These data demonstrate that feeding a pelleted diet improved ADG compared with feeding a meal diet; however, the magnitude of the response was inconsistent between trials. In addition, F/G was improved by pelleting in the first trial, with no effect found in the second trial. One explanation for this difference might be the quality of the pellets. Samples of the pelleted diets collected in Exp. 1 contained approximately 25% fines, whereas samples of the pelleted diets in Exp. 2 were composed of approximately 35% fines. Diets formulation (corn-soybean vs. corn-alternative ingredients) can influence pellet quality, which may explain differences between the experiments.

Key words: carcass, growth, pellet

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Introduction

Feeding pelleted diets to pigs has been shown to increase nutrient digestibility and improve F/G from 5% to 8% in finishing pigs fed a corn-soybean meal-based diet under university research conditions. Other advantages to pelleted diets include the ability to grind grain to a smaller micron size and use high percentages of alternative ingredients in the diets and still maintain feed flowability. However, the improvement in F/G may not be as large under field conditions because of poor pellet quality. Increased fine buildup in feed pans and feed wastage are outcomes of a poor quality pellet. Besides the cost of pelleting, another disadvantage to feeding pelleted diets is a mortality increase as a result of gastric ulcers. This susceptibility to ulcers also appears to be dependent on genotype. The recent increase in feed costs has led producers to reevaluate the economics of feeding pelleted finishing pig diets. Therefore, the objective of this study was to determine the effects of feeding a pelleted milo or corn-soybean meal-based diet (Exp. 1) or a diet containing a large proportion of alternative ingredients (Exp. 2) on performance of commercial finishing pigs.

Procedures

Procedures used in these studies were approved by the Kansas State University Institutional Animal Care and Use Committee. Both experiments were performed in commercial research finishing barns located in northeastern Kansas. The barns were naturally ventilated and double curtain sided with completely slatted flooring. Each pen (10 × 18 ft) was equipped with a double swinging waterer and a 3-hole dry self-feeder, allowing for ad libitum access to water and feed. An automated feeding system (FeedPro; Feedlogic Corp., Willmar, MN) was used in each barn to deliver and measure feed amounts added to individual pen feeders.

In Exp. 1, a total of 1,072 pigs (60.7 lb) were used in a 112-d finishing trial. Pigs were sorted by gender (barrow or gilt) and placed in pens with 26 to 28 pigs per pen. Pens of pigs were randomly allotted to a diet form treatment (meal or pellet) with average pig weight balanced across treatments. Treatments were arranged in 2 × 2 factorial design with main effects of gender and diet form in a completely randomized design. Diets were pelleted at a commercial mill with a CPM pellet mill (California Pellet Mill Co., Crawfordsville, IN) with a 3/16 in. die. There were 10 pens per diet form × gender treatment. The same dietary formulation was used for both diet forms. Diets were corn-soybean meal based, except the diet used for the initial batch of feed contained 30% milo to replace a portion of the corn in the diet. Particle size was kept constant so that only the processing form varied among treatment groups. Samples of the pelleted diets were collected at the barn during each phase, and pellet durability index (PDI) was determined on the corn-soybean meal-based diet by using the standard tumbling-box technique. Before testing pellets for durability, fines were removed and quantified. A modified PDI was also conducted by adding 5 hexagon nuts into the tumbling box.

Pens of pigs were weighed and feed intake was recorded on d 0, 14, 28, 41, 56, 70, 90, and 112. From these data, ADG, ADFI, and F/G were calculated. At the conclusion of the study, pigs were individually tattooed with a number corresponding to their pen to facilitate collection of carcass data at harvest. On d 90, the 4 heaviest pigs (“tops”) in each pen were removed and marketed. At the end of the trial, pigs were sold over 2 consecutive days in a balanced fashion, with the last pigs weighed off test on d 112.

In accordance with allowable weight guidelines from the packing plant, pigs weighing more than 215 lb were marketed and carcass data were collected. Lightweight pigs weighing less than 215 lb were held back to allow for additional weight gain. Data from these lightweight pigs are included in all growth and performance data but not in the carcass data.

Finisher growth and feed performance data were analyzed as a completely randomized design using the GLIMMIX procedure of SAS (SAS Institute Inc., Cary, NC) and pen as the experimental unit. Diet form and gender were the main effects. For analysis of carcass characteristics, percentage yield was calculated by dividing HCW by live weight determined at the site prior to transport to the processing plant. For comparisons among treatments for backfat depth, loin depth and percentage lean, HCW was used to adjust responses to a common HCW. Differences among treatments were determined by using least squares means ($P < 0.05$).

In Exp. 2, a total of 1,214 pigs (58.3 lb) were used in a 42-d trial to determine the effects of diet form (meal or pellet) on performance. There were 27 to 28 pigs per single-sex pen, with 11 pens per diet form × gender treatment. Although there were 22 replication pens per gender treatment, gender was confounded with genotype because gilt pens were comprised of progeny from terminal sire-line matings and barrow pens were progeny of maternal or terminal sire-line matings. A common diet containing 32.5% fortified hominy mixture was used for both diet form treatments. Particle size was identical among the treatments. To minimize sources of variation between diet forms, meal diets were made and mixed at a common commercial feed mill, and then 24 tons of complete diet were trucked to an alternate location for pelleting. Diets were pelleted using a 3⁄16 in. die. Because of this transport schedule, the pelleted diets were fed based on a budget of 24 tons per phase, and diets were fed in 2 phases. Meal diet phases matched the phase changes in the pellet treatment. The standard and modified PDI values were determined by using the same procedures as in Exp. 1.

Pens of pigs were weighed and feed intake was recorded on d 0, 14, 28, and 42. From these data, ADG, ADFI, and F/G were calculated.

Performance data were analyzed as a completely randomized design using the GLIMMIX procedure of SAS and pen as the experimental unit. Diet form was analyzed as a fixed effect, and because of the confounding with genotype, gender was considered a random effect. Differences among treatments were determined by using least squares means ($P < 0.05$).

Results and Discussion

In Exp. 1, a gender × diet form interaction ($P \le 0.03$) was observed for ADG from d 0 to 90 and d 90 to 112 (Table 1). From d 0 to 90, within both barrows and gilts, pigs fed pelleted diets had greater ($P < 0.01$) ADG; barrows fed pelleted diets gained 0.19 lb/d more than barrows fed meal diets, and gilts fed pelleted diets gained 0.12 lb/d more than gilts fed meal diets. The magnitude of the response to consuming pelleted diets on ADG from d 0 to 90 was greater in barrows than in gilts; however, from d 90 to 112, barrows fed pelleted diets had decreased ($P < 0.01$) ADG compared with barrows fed meal diets, and there was no difference ($P = 0.74$) in ADG attributable to diet form for gilts. Because of the variability in these data, there was no gender × diet form interaction ($P = 0.22$) observed for overall (d 0 to 112) ADG. From d 0 to 112, there was no difference ($P = 0.69$) in feed intake among pigs fed meal and pelleted diets (Table 2). Therefore, the greater ($P < 0.01$) overall growth rate in pigs fed pelleted diets compared with pigs fed meal diets is attributable to the difference in F/G between these treatment groups. Pigs fed pelleted diets had a 5.3% improvement (2.68 vs. 2.83, $P < 0.01$) in overall F/G compared with pigs fed meal diets. These data support findings previously reported in the literature for improvements in feed efficiency achievable with feeding corn-soybean meal-based pelleted diets. With the improvements in F/G driving the increased gain for pellet-fed pigs, pigs consuming pellets were 13.6 lb heavier ($P < 0.01$) at off test than meal-fed pigs. From d 0 to 112, barrows had greater ($P < 0.01$) ADG and ADFI and poorer ($P < 0.01$) F/G than gilts.

Similar to live weight results, pigs fed pellets had heavier ($P < 0.01$) carcasses than pigs fed meal diets (Table 3). Though backfat depth was unaffected ($P = 0.19$) by diet form, there was a trend for pigs fed pelleted diets to be less ($P = 0.07$) lean and have decreased ($P = 0.09$) loin depth.

For other carcass characteristics, there was a gender × diet form interaction ($P = 0.03$) for percentage yield. Barrows fed meal diets had lower (73.4%, $P \leq 0.02$) percentage yield than barrows fed pelleted diets or gilts fed either diet form. There was no difference ($P \geq 0.08$) among barrows fed pellets (74.7%), gilts fed meal diets (74.1%), and gilts fed pellets (74.4%). Overall, barrow carcasses were heavier (214.0 vs. 203.9 lb, $P <0.01$) and less lean (51.9% vs. 54.1%, $P < 0.01$) with increased (21.8 vs. 17.0 mm, $P < 0.01$) backfat depth and decreased (60.3 vs. 62.7 mm, $P < 0.01$) loin depth.

In summary, pigs fed a pelleted corn-soybean meal-based diet had increased ADG compared with pigs fed the same diets in meal form, but the magnitude of the response was gender dependent. Regardless of gender, pigs fed pelleted diets had improved F/G and heavier market and carcass weights than pigs fed meal diets.

In Exp. 2, pigs fed a fortified hominy-based diet in pellet form from d 0 to 42 had greater ($P < 0.01$) ADG than pigs fed the same diet formulation in meal form (Table 4). Feeding pelleted diets improved ($P < 0.05$) F/G from d 14 to 28 and d 28 to 42 but not for the overall trial ($P \geq 0.15$). The F/G improvements were 3.3% from d 14 to 28 and 5.1% from d 28 to 42. The overall response from d 0 to 42 was 2.4%. The growth performance differences resulted in pigs fed pelleted diets having a numerical weight advantage of 4.1 lb at off test compared with pigs fed meal diets.

Differences in pellet quality may have contributed to the lower response in Exp. 2 compared with Exp. 1. It was unknown what pellet quality would be achievable with the diet containing alternative ingredients. Although it was possible to produce a pelleted diet with this base diet, the quality of the pellet was poorer than that of the corn-soybean meal-based pellet used in Exp. 1. Samples of the pelleted diets collected in Exp. 1 contained approximately 25% fines, whereas samples of the pelleted diets in Exp. 2 were composed of approximately 35% fines. Standard and modified PDI average values were 87% and 80%, respectively, for both experiments. The PDI analysis was conducted after fines were removed from the samples.

Additional research needs to be completed with fortified hominy-based diets to help further explain the variability in the responses found in these experiments. These trials indicate that the magnitude of expected response appears to be affected by diet composition and pellet quality.

Table 1. Effect of gender and diet form on growth performance of finishing pigs (Exp. 1)[1]

	Barrow		Gilt			Gender × Form
Diet form[2]:	Meal	Pellet	Meal	Pellet	SEM	$P <$
d 0 to 90						
Initial wt, lb	60.6	60.8	60.8	60.6	0.9	0.81
ADG, lb	1.96[a]	2.15[b]	1.85[c]	1.97[a]	0.02	0.03
ADFI, lb	5.39	5.57	4.87	4.92	0.06	0.26
F/G	2.75	2.59	2.63	2.50	0.02	0.41
d-90 wt, lb	238.2[a]	257.4[b]	229.2[c]	239.8[b]	2.0	0.04
d 90 to 112[3]						
ADG, lb	2.12[a]	1.98[b]	1.83[c]	1.85[c]	0.04	0.03
ADFI, lb	7.55	6.96	6.45	6.17	0.09	0.11
F/G	3.57	3.52	3.54	3.34	0.06	0.27
d 0 to 112						
ADG, lb	1.99	2.12	1.85	1.95	0.02	0.22
ADFI, lb	5.74	5.80	5.13	5.12	0.06	0.60
F/G	2.89	2.73	2.77	2.63	0.02	0.70
Final wt, lb	276.8	293.0	261.3	272.3	2.4	0.30

[1] A total of 1,072 pigs with 26 to 28 pigs per pen were used in a 112-d trial. There were 10 replication pens per gender × diet form treatment.
[2] A common corn-soybean meal-based diet was fed in either meal or pellet form (3⁄16 in.).
[3] On d 90, the 4 heaviest pigs per pen were removed and marketed.
[abc] Within a row, means without a common superscript differ ($P < 0.05$).

Table 2. Main effects of diet form on growth performance of finishing pigs (Exp. 1)[1]

	Diet form[2]			Probability, $P <$
Item	Meal	Pellet	SEM	Diet
d 0 to 90				
Initial wt, lb	60.7	60.7	0.7	0.99
ADG, lb	1.91	2.06	0.01	<0.01
ADFI, lb	5.13	5.25	0.04	0.05
F/G	2.69	2.54	0.01	<0.01
d-90 wt, lb	233.7	248.6	1.4	<0.01
d 90 to 112[3]				
ADG, lb	1.98	1.91	0.03	0.09
ADFI, lb	7.00	6.57	0.07	<0.01
F/G	3.55	3.43	0.04	0.06
d 0 to 112				
ADG, lb	1.92	2.04	0.01	<0.01
ADFI, lb	5.44	5.46	0.04	0.69
F/G	2.83	2.68	0.01	<0.01
Final wt, lb	269.0	282.6	1.7	<0.01

[1] A total of 1,072 pigs with 26 to 28 pigs per pen were used in a 112-d trial. There were 20 replication pens per diet form treatment.
[2] A common corn-soybean meal-based diet was fed in either meal or pellet form (3/16 in.).
[3] On d 90, the 4 heaviest pigs per pen were removed and marketed.

Table 3. Effect of diet form on carcass characteristics of finishing pigs (Exp. 1)[1]

	Diet form[2]			Probability, $P <$	
Item	Meal	Pellet	SEM	Diet	Gender × Diet form
no. of pigs (> 215 lb) marketed	473	480	---	---	---
no. of pigs (< 215 lb) held back	45	29	---	---	---
Overall marketing[3,4,5]					
Live wt, lb	275.6	287.7	1.5	<0.01	0.69
HCW, lb	203.4	214.5	1.3	<0.01	0.30
Yield, %[6]	73.8	74.5	0.1	<0.01	0.03
Lean, %[7]	53.2	52.8	0.1	0.07	0.56
Backfat depth, mm[7]	19.1	19.7	0.3	0.19	0.40
Loin depth, mm[7]	62.0	61.0	0.4	0.09	0.22

[1] A total of 953 pigs (d 90: 160 pigs; d 111 and 112: 793 pigs) are represented in the carcass data from 20 replication pens per diet form treatment.
[2] A common corn-soybean meal-based diet was fed in either meal or pellet form.
[3] On d 90, the 4 heaviest pigs per pen were removed and marketed.
[4] On d 111 and 112, pigs greater than 215 lb were marketed for carcass data collection.
[5] Overall marketing data combines data from all pigs marketed on d 90 and 112.
[6] Percentage yield was calculated by dividing HCW by live weight obtained prior to transport to the packing plant.
[7] Percentage lean, backfat depth, and loin depth were adjusted to a common HCW.

Table 4. Effect of diet form on growth performance of finishing pigs (Exp. 2)[1]

	Diet form[2]			
Item	Meal	Pellet	SEM	Probability, *P* <
d 0 to 14				
ADG, lb	1.87	1.83	0.06	0.39
ADFI, lb	3.56	3.58	0.12	0.85
F/G	1.90	1.95	0.02	0.12
d 14 to 28				
ADG, lb	1.72	1.97	0.07	<0.01
ADFI, lb	3.76	4.17	0.17	<0.01
F/G	2.19	2.12	0.03	0.05
d 28 to 42				
ADG, lb	2.27	2.34	0.10	0.03
ADFI, lb	5.11	5.01	0.32	0.23
F/G	2.25	2.14	0.05	0.01
d 0 to 42				
ADG, lb	1.95	2.05	0.08	<0.01
ADFI, lb	4.14	4.25	0.20	0.24
F/G	2.12	2.07	0.03	0.15
Weight, lb				
d 0	58.2	58.3	1.8	0.98
d 42	140.4	144.5	4.8	0.14

[1] A total of 1,214 pigs (27 to 28 pigs per pen) were used in a 42-d trial. There were 22 replication pens per diet form treatment.

[2] A common diet consisting of 32.5% fortified hominy mixture was fed in either meal or pellet form.