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Effects of Feeding a Finishing Diet Blended with Different Phases of Nursery Diets on Growth Performance and Economics of Nursery Pigs

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Abstract

A total of 1,260 weaned pigs (PIC TR4 × (Fast LW × PIC L02); initially 12.9 lb BW)) were housed in a commercial research barn and used in a 47-d study to determine the effects of blending a finishing diet into different phases of nursery diets on pig growth performance. Pens of pigs were blocked by initial BW and gender and allotted to 1 of 4 treatment groups (15 pens/treatment). In a 5-phase feeding program, the 4 treatments were: 1) standard nursery diets throughout (control); or standard nursery diets with 5.5 lb/pig of late finishing feed blended at the beginning of 2) Phase 2; 3) Phase 3; or 4) Phase 4. Phase changes were based on feed budgets. From d 0 to 7, all pigs received the same standard Phase 1 diet and had similar growth performance. Compared with pigs from control, blending finishing feed into the Phase 2 period resulted in poorer ($P < 0.01$) ADG, ADFI, and F/G from d 7 to 14, poorer ($P = 0.025$) F/G from d 21 to 28, decreased ($P = 0.028$) ADG from d 28 to 35, and decreased ($P < 0.05$) ADFI and F/G from d 35 to 47. Blending finishing feed during Phase 3 resulted in worsened ($P < 0.001$) ADG and F/G from d 14 to 21, decreased ($P = 0.010$) ADG from d 21 to 28, and lower ($P < 0.05$) ADFI and F/G from d 35 to 47 compared with control pigs. Pigs that received blended diet in Phase 4 had impaired ($P < 0.001$) ADG and F/G from d 21 to 28, but had improved ($P = 0.010$) F/G from d 35 to 47. Overall (d 0 to 47), blending the finishing diet into Phase 2 decreased ($P < 0.05$) ADG, ADFI, and final BW, but did not affect F/G compared with control pigs or pigs that had finishing feed blended into the Phase 4. Blending finishing feed into Phase 3 or 4 did not influence overall growth performance. Pigs that had finishing feed blended into Phase 2 or 3 had lower ($P < 0.05$) overall feed costs than pigs from control and Phase 4 blending treatments. Gain value was decreased ($P < 0.05$) when finishing feed was blended into Phase 2 compared with the control or when feed was blending into Phase 4. However, no differences in feed cost per lb of gain and only numerical differences in income over feed cost were observed among the treatments. In conclusion, feeding finishing feed in early nursery phase negatively affected pig growth performance; however, blending approximately 5.5 lb/pig finishing feed into nursery diets for pigs greater than 22 lb BW did not affect overall growth performance.

Keywords

blending, finishing feed, nursery feed, growth, nursery pig

Cover Page Footnote

Appreciation is expressed to New Fashion Pork (Jackson, MN) for use of research facilities and Doug Garry and Dylan Smith for technical support.

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K-STATE Research and Extension

Swine Day 2016

Effects of Feeding a Finishing Diet Blended with Different Phases of Nursery Diets on Growth Performance and Economics of Nursery Pigs[1]

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Summary

A total of 1,260 weaned pigs (PIC TR4 × (Fast LW × PIC L02); initially 12.9 lb BW)) were housed in a commercial research barn and used in a 47-d study to determine the effects of blending a finishing diet into different phases of nursery diets on pig growth performance. Pens of pigs were blocked by initial BW and gender and allotted to 1 of 4 treatment groups (15 pens/treatment). In a 5-phase feeding program, the 4 treatments were: 1) standard nursery diets throughout (control); or standard nursery diets with 5.5 lb/pig of late finishing feed blended at the beginning of 2) Phase 2; 3) Phase 3; or 4) Phase 4. Phase changes were based on feed budgets. From d 0 to 7, all pigs received the same standard Phase 1 diet and had similar growth performance. Compared with pigs from control, blending finishing feed into the Phase 2 period resulted in poorer ($P < 0.01$) ADG, ADFI, and F/G from d 7 to 14, poorer ($P = 0.025$) F/G from d 21 to 28, decreased ($P = 0.028$) ADG from d 28 to 35, and decreased ($P < 0.05$) ADFI and F/G from d 35 to 47. Blending finishing feed during Phase 3 resulted in worsened ($P < 0.001$) ADG and F/G from d 14 to 21, decreased ($P = 0.010$) ADG from d 21 to 28, and lower ($P < 0.05$) ADFI and F/G from d 35 to 47 compared with control pigs. Pigs that received blended diet in Phase 4 had impaired ($P < 0.001$) ADG and F/G from d 21 to 28, but had improved ($P = 0.010$) F/G from d 35 to 47. Overall (d 0 to 47), blending the finishing diet into Phase 2 decreased ($P < 0.05$) ADG, ADFI, and final BW, but did not affect F/G compared with control pigs or pigs that had finishing feed blended into the Phase 4. Blending finishing feed into Phase 3 or 4 did not influence overall growth performance. Pigs that had finishing feed blended into Phase 2 or 3 had lower ($P < 0.05$) overall feed costs than pigs from control and Phase 4 blending treatments. Gain value was decreased ($P < 0.05$) when finishing feed was blended into Phase 2 compared with the control or when feed was blending into Phase 4. However, no differences in feed cost per lb of gain and only numerical differences in income over

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feed cost were observed among the treatments. In conclusion, feeding finishing feed in early nursery phase negatively affected pig growth performance; however, blending approximately 5.5 lb/pig finishing feed into nursery diets for pigs greater than 22 lb BW did not affect overall growth performance.

Key words: blending, finishing feed, nursery feed, growth, nursery pig

Introduction

In a wean-to-finish pig production, one of the challenges in feed management is determining what to do with feed remaining in the bin at the end of the finishing phase. The precision of budgeting finishing feed based on predicted feed intake and closeout dates is not perfect. Thus, there is often feed remaining in the bins that must be removed and transported to another site or fed to the next group of pigs. However, in a wean-to-finish barn this happens to be newly weaned nursery pigs. A common strategy is to blend leftover finishing feed into late nursery diets, which requires prolonged feed storage and may result in tandem blending of the early nursery phase diets. Therefore, information on the timing of blending finishing feed into nursery diets is needed to quantify and mitigate the negative impact. This study was designed to replicate a common field scenario where 6 tons of the last finishing diet was left in the bins at a 2,200-head barn. Thus, approximately 5.5 lb finishing feed would be fed to each nursery pig in the subsequent turn. The objective of this study was to determine the effects of feeding finishing feed blended into different phases of nursery feed on nursery pig growth performance and production economics.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in the experiment. The study was conducted at New Fashion Pork's nursery research facility located in southwest Minnesota. The barn was equipped with pens (8.5 × 18.25 ft^2) that contained a 3-hole dry self-feeder and a cup waterer to allow for ad libitum access to feed and water. Diets were manufactured at the New Fashion Pork feedmill located in Worthington, MN.

A total of 1,260 weaned pigs (PIC TR4 × (Fast LW × PIC L02); initially 12.9 lb BW) were used. Pens of pigs (21 pigs/pen, 30 pens of barrows, and 30 pens of gilts) were blocked by initial BW and gender. Within blocks, pens were allotted randomly to 1 of 4 treatments with 15 replications per treatment. Pigs were fed a 5-phase feeding program (Table 1) with phase changes made by using feed budgets (Table 2). Treatments consisted of a standard 5-phase nursery diet program (control) and the standard program with 5.5 lb of the last finishing diet blended at the beginning of Phase 2, 3, or 4. In the blended diets, feed delivery followed the sequence of 2.75 lb/pig of late finishing feed, a 50:50 blend of late finishing and standard diet, and ended with the remaining budget of the standard nursery diet.

Feed additions to each individual pen were delivered and recorded by a robotic feeding system (FeedPro; Feedlogic Corp., Wilmar, MN). Pens were weighed and feed disappearance was measured every 7 d to determine ADG, ADFI, and F/G. Nine feed samples (5 standard nursery diets, 1 finishing diet, and 3 blended diets) were collected

directly from the feed robot delivery outlet. Feed samples were delivered to the Kansas State University Swine Laboratory, stored at -68°F, and analyzed for DM, CP, and mineral contents (Ward Laboratories, Inc., Kearney, NE).

Data were analyzed using the GLIMMIX procedure of SAS (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. The statistical model included the fixed effect of blending phase and random effects of weight block and gender. Calculation of economics were based on a gain value of $0.60/lb and feed prices of $521, $449, $389, $297, $265, and $172/ton of nursery Phase 1, 2, 3, 4, 5, and late finishing diets respectively. Results were considered significant at $P < 0.05$ and marginally significant at $0.05 < P < 0.10$.

Results and Discussion

As expected, the finishing diet contained lower CP, Ca, and P concentrations than nursery diets (Table 3). Nutrient concentrations in blended diets approximated to the average between the finishing diet and the corresponding standard nursery diet phase, indicating that diets were properly blended.

From d 0 to 7 (all received standard Phase 1 diet), there were no differences in growth performance and d 7 BW as expected (Table 4). From d 7 to 14 (Phase 2 diets), pigs that received late finishing feed blended into the Phase 2 diet had poorer ($P < 0.01$) ADG, ADFI, F/G, and d 14 BW compared with pigs in other treatment groups. From d 14 to 21 (Phase 3 budgets), blending late finishing feed into the Phase 3 diet resulted in poorer ($P < 0.01$) ADG and F/G than other treatments, but no differences in ADFI were observed. Body weights of pigs fed late finishing diet blended into Phase 2 or Phase 3 were lower ($P < 0.05$) than pigs from control and Phase 4 blending treatments on d 21.

Between d 21 and 28 the switch from the Phase 3 to Phase 4 budgets occurred in the majority of the pens. During this period, ADG of pigs with late finishing feed blended into the Phase 3 or Phase 4 diets was lower ($P < 0.05$) than that of pigs from control, but was not different from pigs in Phase 2 blending treatment. No difference in ADG among pigs from control and Phase 2 blending treatment was observed. Pigs with late finishing feed blended into the Phase 3 diet had lower ($P = 0.002$) ADFI than pigs from the Phase 4 blending treatment with pigs from the control and Phase 2 blending treatments being intermediate. Pigs receiving late finishing feed blended into the Phase 4 blended diet had poorer ($P < 0.01$) F/G than pigs from other treatments. Also, F/G of pigs from Phase 2 blending treatment was poorer ($P = 0.025$) than that of pigs from the control, but was not different from pigs from the Phase 3 blending treatment. On d 28, BW of pigs that received late finishing feed blended into the Phase 2 or Phase 3 diets was lower ($P < 0.05$) than pigs from control and Phase 4 blending treatments.

From d 28 to 35, the majority of the pens were fed their Phase 4 budgets with the diet change from Phase 4 to 5 occurring at the end of this period. A tendency for a treatment effect was observed for ADG with pigs that had received finishing feed blended into the Phase 2 diet having decreased ($P < 0.05$) ADG compared with pigs from other treatment groups; however, no differences in ADFI and F/G were observed. On d 35, BW of pigs that received late finishing feed blended during Phase 2 was lower

($P < 0.01$) than pigs from control and Phase 4 blending treatments, but was not different from pigs from Phase 3 blending treatment. Pigs that received late finishing feed blended into the Phase 3 diet also had lower ($P = 0.013$) BW than pigs from the control treatment. Pigs receiving late finishing feed blended into the Phase 4 diet had similar BW compared with control pigs on d 35.

From d 35 to 47, all pigs were fed a standard Phase 5 diet. Average daily gain was similar among treatments. Pigs receiving late finishing feed blended into the Phase 2 or Phase 3 diets had decreased ($P < 0.05$) ADFI compared with control pigs, but they were not different from pigs from Phase 4 blending treatment. Feed efficiency was improved ($P < 0.01$) in pigs that previously had late finishing feed blended into their diets compared with the control. Pigs from Phase 3 blending treatment also had better ($P = 0.020$) F/G than pigs from Phase 4 blending treatment.

Overall, blending finishing diet during Phase 2 resulted in decreased ($P < 0.05$) ADG, ADFI, and final BW, but did not affect F/G compared with control pigs or pigs that had late finishing diet blended diet into the nursery Phase 4. No differences in growth performance were observed among pigs from control, Phase 3 blending, and Phase 4 blending treatments.

Blending the finishing diet in Phase 2 decreased growth performance immediately and the negative effects persisted during the subsequent periods. Pigs in early nursery phases are in an energy deficient state and their growth performance is highly dependent on the feed intake. Late finishing diets contain less special protein ingredients and is less palatable, which may be responsible to a low ADFI of young pigs. In addition, late finishing diets are low in AA, Ca, and P concentrations that are below the requirements of nursery pigs and prevent pigs from achieving maximum growth performance. When finishing feed was blended in Phase 3 or Phase 4, decreased growth performance was also observed. However, pigs receiving the blended diets in the later phases were able to maintain or increase feed intake to compensate partly for the negative impact of consuming the late finishing diet. Therefore, these pigs resumed the growth performance to the control level faster and in a greater degree compared with pigs receiving the finishing diet during Phase 2. Interestingly, pigs that received blended diets expressed superior feed efficiency compared with pigs fed no blended diets from d 35 to 47, which might be a result of the decreased feed intake and compensatory gain, but further investigation is needed to fully explain this observation.

Economic analysis is presented in Table 5. Blending finishing feed into Phase 2 or 3 decreased ($P < 0.05$) feed cost relative to control pigs and pigs that received blended diet in Phase 4 which can be explained by the slightly decreased overall feed intake and lower cost of the late finishing diet. The lower final BW also caused pigs that received late finishing diet during Phase 2 to have lower ($P < 0.05$) gain value than pigs from control and Phase 4 blending treatments, with no differences in gain value observed among control, Phase 3 blending, and Phase 4 blending treatments. No treatment effect was observed for feed cost per lb of gain. Income over feed cost was numerically decreased in pigs fed blended diets, and the magnitude was greater when pigs received the blended diet at a younger age; however, no significant difference was detected. Based on standard labor and transportation costs, approximately $500 is need to reclaim 6 tons

of finishing feed to a feed mill located 40 miles away from the barn. In this scenario, the reclaim cost per pig ($0.23) is less than the numerical reductions in income over feed cost when blending finishing feed into Phase 2 ($0.69/pig), Phase 3 ($0.42/pig), and Phase 4 ($0.32/pig).

In summary, growth performance of nursery pigs was promptly influenced when blended finishing and nursery diets were fed, and its magnitude depended on which phase the finishing feed was blended in. However, for pigs greater than 22 lb BW, blending approximately 5.5 lb/pig finishing feed into nursery diets did not affect overall growth performance. Based on numerical differences observed in income over feed cost, it was not economical to feed 5.5 lb/pig of leftover finishing feed to nursery pigs in the test scenario.

Table 1. Composition of experimental diets (as-fed basis)

Items	Phase 2	Phase 3	Phase 4	Phase 5	Finishing
Ingredients, %					
Corn	43.14	39.27	37.07	38.39	79.00
Soybean meal (48% CP)	23.75	27.05	32.60	29.30	14.75
Corn DDGS	7.50	15.00	20.00	25.00	---
Nursery supplement	15.75	10.00	---	---	---
Limestone	0.70	0.95	1.05	1.28	0.70
Monocalcium phosphate (22% P)	0.84	0.83	0.60	0.65	0.15
Sodium chloride	0.35	0.38	0.26	0.31	0.53
Vitamin and mineral premix	0.08	0.10	0.15	0.15	0.10
L-Lys HCl	0.55	0.55	0.46	0.49	0.35
L-Thr	0.20	0.18	0.12	0.12	0.12
L-Trp	0.07	0.07	0.05	0.05	0.02
DL-Met	0.07	0.10	0.17	0.14	0.08
Choline chloride	0.01	---	---	---	---
Beef tallow	1.95	2.95	4.45	3.60	3.85
Phytase[1]	0.04	0.04	0.02	0.02	-
AV-E Digest[2]	5.00	2.50	2.50	-	-
XFE Liquid Energy[3]	---	---	0.50	0.50	0.25
Tri-basic copper chloride	---	0.03	---	---	---
Lipinate[4]	---	---	---	---	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Standardized ileal digestible (SID) AA, %					
Lys	1.40	1.40	1.41	1.32	0.81
Ile:Lys	57	58	62	62	56
Met and Cys:Lys	58	58	58	58	60
Thr:Lys	63	63	62	62	66
Trp:Lys	20	20	20	20	18
Val:Lys	67	67	68	68	66
Total Lys, %	1.56	1.56	1.58	1.48	0.89
CP, %	22.10	22.78	24.18	22.84	12.45
ME, kcal/lb	1,515	1,515	1,543	1,517	1,567
NE, kcal/lb	1,041	1,082	1,120	1,130	1,230
SID Lys:ME, g/Mcal	4.02	4.04	4.00	3.80	2.05
Ca, %	0.78	0.78	0.75	0.75	0.37
P, %	0.71	0.71	0.68	0.68	0.34
Available P, %	0.43	0.43	0.45	0.45	0.19

[1] Ronozyme HiPhos (DSM Nutritional Products, Inc., Parsippany, NJ).
[2] AV-E Digest (XFE Products, Des Moines, IA).
[3] Liquid Energy (XFE Products, Des Moines, IA).
[4] Lipinate (Nutriquest LLC, Mason City, IA).

Table 2. Feed budgets per pig averaged within treatments

		Blended diets[1]		
Phase	Control	Phase 2	Phase 3	Phase 4
Phase 1	5.47 lb	5.47 lb	5.47 lb	5.47 lb
Phase 2	8.07 lb	2.75 lb late finishing feed, 5.5 lb 50:50% blend, 5.5 lb standard Phase 2	8.07 lb	8.07 lb
Phase 3	8.07 lb	8.07 lb	2.75 lb late finishing feed, 5.5 lb 50:50% blend, 5.5 lb standard Phase 3[2]	8.07 lb
Phase 4	21 lb	21 lb	21 lb	2.75 lb late finishing feed, 5.5 lb 50:50% blend, 5.5 lb standard Phase 4
Phase 5	21 lb	15.5 lb	15.5 lb	15.5 lb

[1] Finishing feed was blended with standard nursery diets in different phases; blended diets were delivered in the sequence of finishing feed, 50% finishing and 50% standard blended diet, and standard diet.
[2] Three pens received the blended diets in the order of 50% finishing and 50% standard blended diet, finishing feed, and standard diet due to mistake.

Table 3. Analyzed nutrient composition of experimental diets[1]

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Finishing	50% Phase 2: 50% finishing blend	50% Phase 3: 50% finishing blend	50% Phase 4: 50% finishing blend
DM, %	89.2	89.6	89.1	88.5	87.2	87.8	88.5	88.7	87.7
CP, %	22.3	23.8	23.8	24.5	19.1	13.6	19.2	18.5	18.8
Ca, %	1.02	1.01	0.95	0.96	0.87	0.62	0.80	0.87	0.79
P, %	0.71	0.88	0.70	0.70	0.52	0.31	0.53	0.54	0.49
Zn, ppm	2,335	3,466	1,733	151	117	114	1,529	821	137
Cu, ppm	88	209	246	186	141	155	219	184	185

[1] Multiple samples of each diet were collected, blended and subsampled, and analyzed (Ward Laboratories, Inc., Kearney, NE).

Table 4. Effects of blending finishing feed into different phases of nursery diets on growth performance[1]

		Blended diets[2]				
	Control	Phase 2	Phase 3	Phase 4	SEM	*P* value
BW, lb						
d 0	12.8	12.9	12.9	12.9	0.112	0.976
d 7	15.5	15.6	15.5	15.5	0.153	0.962
d 14	21.6[a]	20.6[b]	21.8[a]	21.9[a]	0.294	<0.001
d 21	28.1[a]	26.8[b]	27.2[b]	28.3[a]	0.347	<0.001
d 28	35.7[a]	34.2[b]	34.2[b]	35.3[a]	0.369	0.001
d 35	45.8[a]	43.7[c]	44.3[bc]	45.3[ab]	0.484	0.003
d 47	66.2[a]	64.1[b]	64.8[ab]	65.9[a]	0.565	0.018
d 0 to 7						
ADG, lb	0.38	0.39	0.37	0.38	0.019	0.880
ADFI, lb	0.38	0.36	0.38	0.39	0.014	0.369
F/G	1.00	0.96	1.03	1.07	0.046	0.277
d 7 to 14						
ADG, lb	0.88[a]	0.73[b]	0.89[a]	0.91[a]	0.026	<0.001
ADFI, lb	0.99[a]	0.91[b]	0.98[a]	1.01[a]	0.029	0.002
F/G	1.13[a]	1.25[b]	1.11[a]	1.11[a]	0.021	<0.001
d 14 to 21						
ADG, lb	0.91[a]	0.89[a]	0.76[b]	0.90[a]	0.024	<0.001
ADFI, lb	1.23	1.23	1.23	1.23	0.024	0.991
F/G	1.35[a]	1.39[a]	1.62[b]	1.38[a]	0.033	<0.001
d 21 to 28						
ADG, lb	1.10[a]	1.05[ab]	1.03[b]	1.00[b]	0.018	0.003
ADFI, lb	1.44[ab]	1.44[ab]	1.39[b]	1.48[a]	0.021	0.018
F/G	1.32[a]	1.38[b]	1.35[ab]	1.49[c]	0.019	<0.001
d 28 to 35						
ADG, lb	1.43[a]	1.36[b]	1.43[a]	1.43[a]	0.023	0.067
ADFI, lb	1.95	1.91	1.95	2.01	0.035	0.236
F/G	1.37	1.41	1.36	1.41	0.020	0.174
d 35 to 47						
ADG, lb	1.70	1.69	1.72	1.71	0.018	0.644
ADFI, lb	2.86[a]	2.75[b]	2.76[b]	2.81[ab]	0.034	0.048
F/G	1.69[a]	1.62[bc]	1.61[c]	1.64[b]	0.012	<0.001
d 0 to 47						
ADG, lb	1.13[a]	1.09[b]	1.11[ab]	1.12[a]	0.012	0.031
ADFI, lb	1.62[a]	1.57[b]	1.59[ab]	1.63[a]	0.018	0.045
F/G	1.43	1.44	1.43	1.45	0.007	0.140

[1] A total of 1,260 weaned pigs (PIC TR4 × (Fast LW × PIC L02) with initial BW of 12.9 lb were used in a 47-d growth trial with 21 pigs per pen and 15 replications (pen) per treatment.

[2] Approximately 5.5 lb/pig of late finishing feed was blended with standard nursery diets at the beginning of different phases (as feed budgets presented in Table 2).

[abc] Means with different superscripts within a row differ ($P < 0.05$).

Table 5. Effects of blending finishing feed into different phases of nursery diets on production economics[1]

		Blended diets[2]				
Item	Control	Phase 2	Phase 3	Phase 4	SEM	*P* value
Economics, $/pig						
Feed cost[3]	12.37[a]	11.74[b]	12.01[b]	12.39[a]	0.134	<0.001
Gain value[4]	31.95[a]	30.64[b]	31.18[ab]	31.64[a]	0.334	0.031
Feed cost/lb gain[5]	0.232	0.231	0.230	0.234	0.0020	0.410
IOFC[6]	19.58	18.89	19.16	19.26	0.261	0.317

[1] A total of 1,260 weaned pigs (PIC TR4 × (Fast LW × PIC L02) with initial BW of 12.9 lb were used in a 47-d growth trial with 21 pigs per pen and 15 replications (pen) per treatment.
[2] Approximately 5.5 lb/pig of late finishing feed was blended with standard nursery diets at the beginning of different phases (as feed budgets presented in Table 2).
[3] Feed cost = diet cost × feed consumption.
[4] Gain value = total BW gain × $0.60/lb.
[5] Feed cost per pound of gain = feed cost / (ADG × period length, d).
[6] Income over feed cost = gain value – feed cost.
[ab] Means with different superscripts within a row differ ($P < 0.05$).