Kansas Agricultural Experiment Station Research Reports

Volume 3
Issue 7 *Swine Day*

Article 49

2017

Effects of Added Defusion or Feed Aid on Finishing Pig Growth Performance from 45 to 243 lb

D. Shawk
Kansas State University, Manhattan, dshawk@ksu.edu

S. S. Dritz
Kansas State University, Manhattan, dritz@k-state.edu

M. D. Tokach
Department of Animal Science and Industry, Kansas State University, mtokach@ksu.edu

See next page for additional authors

Recommended Citation

Shawk, D.; Dritz, S. S.; Tokach, M. D.; Woodworth, J. C.; Goodband, R. D.; and DeRouchey, J. M. (2017) "Effects of Added Defusion or Feed Aid on Finishing Pig Growth Performance from 45 to 243 lb," *Kansas Agricultural Experiment Station Research Reports*: Vol. 3: Iss. 7. https://doi.org/10.4148/2378-5977.7502

Effects of Added Defusion or Feed Aid on Finishing Pig Growth Performance from 45 to 243 lb

Abstract

A total of 1,188 pigs (PIC 359 × 1050; initial BW 45.1 lb) were used in a 112-d growth trial to determine the effects of Defusion (Provimi, Brooksville, OH) or Feed Aid (NutriQuest, Mason City, IA) on finishing pig performance from 45 to 243 lb in a commercial setting. Pens of pigs were blocked by BW and then randomly assigned to 1 of 4 dietary treatments in a completely randomized block design with 27 pigs per pen and 11 pens per treatment. Dietary treatments were fed in a 4-phase feeding program from approximately 45 to 83, 83 to 136, 136 to 196, and 196 to 243 lb BW. The four treatment diets included a positive control (corn-soybean meal-based diet), a negative control (corn-soybean meal-based diet containing 40% dried distillers grains with solubles), or the negative control diet with either 0.25% Defusion or 0.25% Feed Aid. Mycotoxin analysis indicated the deoxynivalenol (DON) concentrations of the treatment diets varied by treatment and phase, but all concentrations were less than 1 ppm. From d 0 to 28, pigs fed the negative control diet or the diet containing Feed Aid had decreased ($P < 0.05$) ADG and d 28 BW compared to those fed the positive control, with pigs fed Defusion treatment intermediate. Pigs fed the positive control diet had greater ($P < 0.05$) ADFI compared to other diets. There was no evidence of difference for F/G. From d 28 to 56, pigs fed the positive control diet had greater ($P < 0.05$) ADG and d 56 BW compared to the other dietary treatments. Pigs fed diets containing Feed Aid or Defusion had greater ($P < 0.05$) ADG compared to the negative control. Average daily feed intake was not influenced by dietary treatments. Pig fed the negative control diet had poorer ($P < 0.05$) F/G when compared to the other dietary treatments. There were no differences in performance from d 56 to 112. Overall, pigs fed the positive control had greater ($P < 0.05$) ADG and final BW when compared to the other dietary treatments, with no evidence of differences in ADFI or F/G. In conclusion, the addition of Defusion improved growth rate during the first two phases of the study and Feed Aid improved growth rate during the second phase. However, neither feed additive improved overall growth performance of finishing pigs when the dietary DON concentration was less than 1 ppm.

Keywords

deoxynivalenol, preservatives, finishing pig, sodium metabisulfite, vomitoxin

Cover Page Footnote

Appreciation is expressed to New Horizon Farm (Pipestone, MN) for providing the animals and research facilities, and to H. Houslog, M. Heintz, and C. Stech for technical assistance.

Authors

D. Shawk, S. S. Dritz, M. D. Tokach, J. C. Woodworth, R. D. Goodband, and J. M. DeRouchey

Effects of Added Defusion or Feed Aid on Finishing Pig Growth Performance from 45 to 243 lb[1]

D.J. Shawk, S.S. Dritz,[2] M.D. Tokach, J.C. Woodworth, R.D. Goodband, and J.M. DeRouchey

Summary

A total of 1,188 pigs (PIC 359 × 1050; initial BW 45.1 lb) were used in a 112-d growth trial to determine the effects of Defusion (Provimi, Brooksville, OH) or Feed Aid (NutriQuest, Mason City, IA) on finishing pig performance from 45 to 243 lb in a commercial setting. Pens of pigs were blocked by BW and then randomly assigned to 1 of 4 dietary treatments in a completely randomized block design with 27 pigs per pen and 11 pens per treatment. Dietary treatments were fed in a 4-phase feeding program from approximately 45 to 83, 83 to 136, 136 to 196, and 196 to 243 lb BW. The four treatment diets included a positive control (corn-soybean meal-based diet), a negative control (corn-soybean meal-based diet containing 40% dried distillers grains with solubles), or the negative control diet with either 0.25% Defusion or 0.25% Feed Aid. Mycotoxin analysis indicated the deoxynivalenol (DON) concentrations of the treatment diets varied by treatment and phase, but all concentrations were less than 1 ppm. From d 0 to 28, pigs fed the negative control diet or the diet containing Feed Aid had decreased ($P < 0.05$) ADG and d 28 BW compared to those fed the positive control, with pigs fed Defusion treatment intermediate. Pigs fed the positive control diet had greater ($P < 0.05$) ADFI compared to other diets. There was no evidence of difference for F/G. From d 28 to 56, pigs fed the positive control diet had greater ($P < 0.05$) ADG and d 56 BW compared to the other dietary treatments. Pigs fed diets containing Feed Aid or Defusion had greater ($P < 0.05$) ADG compared to the negative control. Average daily feed intake was not influenced by dietary treatments. Pig fed the negative control diet had poorer ($P < 0.05$) F/G when compared to the other dietary treatments. There were no differences in performance from d 56 to 112. Overall, pigs fed the positive control had greater ($P < 0.05$) ADG and final BW when compared to the other dietary treatments, with no evidence of differences in ADFI or F/G. In conclusion, the addition of Defusion improved growth rate during the first two phases of the study and Feed Aid improved growth rate during the second phase. However, neither feed additive improved overall growth performance of finishing pigs when the dietary DON concentration was less than 1 ppm.

[1] Appreciation is expressed to New Horizon Farm (Pipestone, MN) for providing the animals and research facilities, and to H. Houslog, M. Heintz, and C. Stech for technical assistance.

[2] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.

Introduction

Deoxynivalenol (DON) or vomitoxin, is a mycotoxin produced by the *Fusarium* genus and is commonly found in cereal grains. The concentration of DON in the grain is correlated to the level of stress the plant endures during the growing season, with poor field fertility, harsh weather conditions, and insect damage being the main contributors to the plant's stress. Pigs are sensitive to the level of DON in the diet, with exposure to concentrations above 1 ppm resulting in decreased feed intake and growth, and with higher concentrations causing complete feed refusal and vomiting.[3] The use of DON-contaminated grain in ethanol production will result in dried distiller grains with solubles having DON concentrations that are two to three times greater than the original corn. Because cereal grains and dried distillers grains with solubles are key sources of energy in finishing diets, producers often use different mitigation strategies to reduce the impact of the contaminated feedstuffs. Blending contaminated grain with grain with a lower DON concentration is effective but the logistics and sourcing of clean grain can be challenging, thus producers are often forced to use contaminated grain.[4] Currently there is no DON-detoxifying agent approved by U.S. Food and Drug Administration but there are several products available that are reported to reduce the effects of DON. Feed Aid (NutriQuest, Mason City, IA) is a commercially available preservative and anti-caking agent that contains sodium metabisulfite, bentonite, and mineral oil. Defusion (Provimi, Brooksville, OH) is another commercially available preservative that contains a combination of sodium metabisulfite, antioxidants, amino acids, and direct-fed microbials. Previous research in nursery pigs indicated improvements in ADG when diets contained Defusion and DON concentration were less than 4 ppm.[5,6] Patience et al.[3] reported improved ADG when finishing diets contained Defusion and the dietary DON concentration was less than 5 ppm. To our knowledge, there is limited research available on the effects of feed additives containing sodium metabisulfite on finishing pig performance in a commercial setting. Therefore, the objective of this experiment was to evaluate the effects of added Defusion or Feed Aid on finishing pig performance from 45 to 243 lb in a commercial environment.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this study. The experiment was conducted at a commercial research finishing site in southwest Minnesota. Pigs were housed in a naturally ventilated and double-curtain-sided barn. Each pen (10 × 18 ft) contained a 4-hole stainless steel feeder and cup waterer for ad libitum access to feed and water. Feed additions to each

---

[3] Patience, J. F., A. J. Myers, S. Ensley, B. M. Jacobs, and D. Madson. 2014. Evaluation of two mycotoxin mitigation strategies in grow-finish swine diets containing corn dried distillers grains with solubles naturally contaminated with deoxynivalenol. J. Anim. Sci. 92:620-626. doi:10.2527/jas.2013-6238.

[4] Patterson, R., and L. G. Young. 1993. Efficacy of hydrated sodium calcium aluminosilicate, screening and dilution in reducing the effects of mold contaminated corn in pigs. Can. J. Anim. Sci. 73:615–624.

[5] Mahan, D. 2010. Evaluation of three commercial mycotoxin inhibitors added to vomitoxin (DON) contaminated corn diets for weanling pigs: A report from the NCCC-042, S-1044, and NCERA-89 regional committees on swine nutrition and management. www.ddgs.umn.edu/prod/groups/cfans/@pub/@cfans/@ansci/documents/asset/cfans _asset_413775.pdf (Accessed 8 December 2012).

[6] Frobose, H. L., E. D. Fruge, M. D. Tokach, E. L. Hansen, J. M. DeRouchey, S. S. Dritz, R. D. Goodband, and J. L. Nelssen. 2015. The effects of deoxynivalenol-contaminated corn dried distillers grains with solubles in nursery pig diets and potential for mitigation by commercially available feed additives. J. Anim. Sci. 93:1074-1088. doi:10.2527/jas.2013-6883.

individual pen were made and recorded by a robotic feeding system (FeedPro; Feedlogic Corp., Wilmar, MN).

A total of 1,188 pigs (PIC 359 × 1050; initial BW 45.1 lb) were used in a 112-d growth trial with 27 pigs per pen and 11 pens per treatment. Pens of pigs were blocked by BW and then randomly assigned to 1 of 4 dietary treatments in a completely randomized block design. The dietary treatments included a positive control, corn-soybean meal-based diet, a negative control, corn-soybean meal-based diet containing 40% dried distillers grains with solubles, or the negative control diet with either 0.25% Defusion (Provimi, Brooksville, OH) or 0.25% Feed Aid (NutriQuest, Mason City, IA). Diets were fed in a 4-phase feeding program from 45 to 83, 83 to 136, 136 to 196, and 196 to 243 lb BW. Thiamine was added to the diets at 10 g/ton at the expense of corn when Defusion or Feed Aid was added to the negative control diet. The inclusion rate of beef tallow was increased to 0.20% when Defusion or Feed Aid was added to the negative control diets to balance for net energy. Pens of pigs were weighed and feed disappearance was recorded at the time of dietary phase change and the conclusion of the trial (d 0, 28, 56, 85, and 112) to determine ADG, ADFI, and F/G.

Diet samples were taken from the feeder at the beginning and the end of each phase, pooled, and subsampled. Subsamples were analyzed for DON, 15-ADON, 3-ADON, nivalenol, and zearalenone (North Dakota State University) NDSU Veterinary Diagnostic Laboratory, Fargo, ND, Table 2).

Growth data were analyzed as a completely randomized block design using PROC GLIMMIX in SAS version 9.4 (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. Individual treatment means were separated using the Tukey-Kramer multiple comparison test. Results were considered significant at $P \leq 0.05$ and marginally significant between $P > 0.05$ and $P \leq 0.10$.

Results and Discussion

Mycotoxin analysis indicated the treatment diets contained less than 0.5 ppm 15-acetyl DON, 3-acetyl DON, nivalenol, and zearalenone. The DON concentration of the diets varied by phase and treatment but all concentrations were less than 1 ppm. The positive control had a DON concentration of 0.5 ppm in phases 2 and 4 and less than 0.5 ppm in phases 1 and 3. The negative control had a DON concentration of 0.5 ppm in phases 1, 2, and 3, and 0.7 ppm in phase 4. The Defusion treatment had a DON concentration of 0.5 ppm in phases 1, 2, and 4 and 0.6 ppm in phase 3. The Feed Aid treatment had a DON concentration less than 0.5 ppm in phase 1, 0.6 ppm in phase 2, and 0.5 ppm in phases 3 and 4.

From d 0 to 28, pigs fed the negative control diet or the diet containing Feed Aid had lower ($P < 0.05$) ADG and d 28 BW compared to the positive control, with the Defusion treatment intermediate (Table 3). Pigs fed the positive control diet had greater ($P < 0.05$) ADFI compared to those fed other diets. There was no evidence of difference to indicate that dietary treatment affected F/G.

From d 28 to 56, pigs fed the positive control diet had greater ($P < 0.05$) ADG and d 56 BW compared to other dietary treatments. Pigs fed diets containing Feed Aid or Defusion had greater ($P < 0.05$) ADG compared to the negative control. Average daily feed intake was not influenced by dietary treatments. Pig fed the negative control diet had poorer ($P < 0.05$) F/G when compared to the other dietary treatments.

From d 56 to 85, there was no evidence of difference to indicate dietary treatment affected ADG, ADFI, or F/G. Pigs fed the positive control diet had greater ($P < 0.05$) d 56 BW when compared to the other dietary treatments.

From d 85 to 112, dietary treatments did not influence ADG, ADFI, and F/G. Pigs fed the positive control diet had greater ($P < 0.05$) d 112 BW when compared to pigs fed Feed Aid or the negative control, with the Defusion treatment intermediate.

Overall, pigs fed the positive control had greater ($P < 0.05$) ADG when compared to the other dietary treatments. There was no evidence of difference to indicate that dietary treatment affected ADFI or F/G.

In conclusion, pigs fed the positive control had improved ADG and final BW compared to pigs fed the Feed Aid treatment, Defusion treatment, and the negative control. Mycotoxin analysis indicated the DON concentration of the diets varied by phase and treatment but all dietary concentrations were less than 1 ppm. The pigs fed Defusion had improved growth rate for the first 2 phases of the study in comparison to the negative control. The pigs fed Feed Aid only had improved performance in phase 2 when compared to the negative control. This might suggest that age of the pig or duration of feeding low levels of DON will impact the degree of DON influence. Overall, the level of DON contamination in the diets fed in this trial was less than anticipated. Additional research should be conducted with diets containing a higher level of DON to determine how these two feed additives impact performance.

Table 1. Diet composition (as-fed basis)[1]

	Dietary phase							
	1		2		3		4	
Treatment	Positive control	Negative control	Positive control	Negative control	Positive control	Negative control	Positive control	Negative control
Corn	66.43	37.72	70.08	41.02	77.43	47.91	81.89	51.91
Soybean meal (48% CP)	30.00	17.94	26.94	15.05	19.90	8.49	15.64	4.41
DDGS[2]	0.00	40.00	0.00	40.00	0.00	40.00	0.00	40.00
Beef tallow	0.85	1.70	0.35	1.30	0.00	1.00	0.00	1.10
Monocalcium P (21% P)	0.75	0.00	0.70	0.00	0.75	0.00	0.60	0.00
Limestone	1.03	1.57	1.00	1.55	0.98	1.52	0.93	1.50
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin and trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
L-Lys- HCl	0.28	0.50	0.28	0.50	0.30	0.50	0.30	0.50
DL-Met	0.08	0.00	0.05	0.00	0.04	0.00	0.03	0.00
L-Thr	0.08	0.05	0.09	0.05	0.09	0.04	0.09	0.04
L-Trp	0.00	0.02	0.01	0.03	0.01	0.03	0.01	0.04
Phytase[3]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Defusion[4]	-	-/+	-/+	-/+	-/+	-/+	-/+	-/+
Feed Aid[5]	-	-/+	-/+	-/+	-/+	-/+	-/+	-/+
Thiamine[6]	-	-/+	-/+	-/+	-/+	-/+	-/+	-/+
Total	100	100	100	100	100	100	100	100

continued

Table 1, *continued*. Diet composition (as-fed basis)[1]

	Dietary phase							
	1		2		3		4	
Treatment	Positive control	Negative control	Positive control	Negative control	Positive control	Negative control	Positive control	Negative control
Calculated analysis								
Standardized ileal digestible (SID) AA, %								
Lys	1.13	1.13	1.06	1.06	0.90	0.90	0.80	0.80
Ile:Lys	64	66	64	66	62	66	61	65
Leu:Lys	134	174	136	180	142	195	148	207
Met:Lys	32	31	30	32	30	34	31	36
Met and Cys:Lys	56	59	55	60	56	65	58	69
Thr:Lys	62	62	62	62	63	63	64	64
Tryp:Lys	18.8	18.5	19.0	18.5	19.0	18.5	18.5	18.5
Val:Lys	70	78	70	79	70	81	70	83
Total Lys, %	1.27	1.34	1.19	1.26	1.02	1.08	0.90	0.97
NE kcal/lb	1,122	1,122	1,122	1,122	1,134	1,134	1,147	1,147
SID Lys:NE, g/Mcal	4.92	4.92	4.62	4.62	3.88	3.88	3.41	3.41
CP, %	19.3	23.0	18.1	21.8	15.3	19.2	13.5	17.5
Ca, %	0.61	0.64	0.58	0.62	0.56	0.59	0.50	0.57
P, %	0.55	0.57	0.52	0.56	0.50	0.53	0.45	0.51
Available P, %	0.34	0.41	0.32	0.41	0.32	0.40	0.29	0.40

[1] Experimental diets were fed in four phases with dietary phases from approximately 45 to 83, 83 to 136, 136 to 196, and 196 to 243 lb BW.
[2] DDGS = dried distillers grains with solubles.
[3] Optiphos 2000 (Huvepharma, Sofia, Bulgaria) provided an estimated release of 0.11% available P.
[4] Defusion (Provimi, Brooksville, OH) included at 0.25% at the expense of corn.
[5] Feed Aid (NutriQuest, Mason City, IA) included at 0.25% at the expense of corn.
[6] Thiamine at 10 g/ton was added at the expense of corn when Defusion or Feed Aid was added to the negative control.

Table 2. Chemical analysis of experimental diets (as-fed basis)[1]

Item, ppm	Positive control	Negative control	Defusion[2]	Feed Aid[3]
Phase 1				
DON[4]	< 0.5	0.5	0.5	< 0.5
15-Acetyl Don	< 0.5	< 0.5	< 0.5	< 0.5
3-Acetyl Don	< 0.5	< 0.5	< 0.5	< 0.5
Nivalenol	< 0.5	< 0.5	< 0.5	< 0.5
Zearalenone	< 0.5	< 0.5	< 0.5	< 0.5
Phase 2				
DON	0.5	0.5	0.5	0.6
15-Acetyl Don	< 0.5	< 0.5	< 0.5	< 0.5
3-Acetyl Don	< 0.5	< 0.5	< 0.5	< 0.5
Nivalenol	< 0.5	< 0.5	< 0.5	< 0.5
Zearalenone	< 0.5	< 0.5	< 0.5	< 0.5
Phase 3				
DON	< 0.5	0.5	0.6	0.5
15-Acetyl Don	< 0.5	< 0.5	< 0.5	< 0.5
3-Acetyl Don	< 0.5	< 0.5	< 0.5	< 0.5
Nivalenol	< 0.5	< 0.5	< 0.5	< 0.5
Zearalenone	< 0.5	< 0.5	< 0.5	< 0.5
Phase 4				
DON	0.5	0.7	0.5	0.5
15-Acetyl Don	< 0.5	< 0.5	< 0.5	< 0.5
3-Acetyl Don	< 0.5	< 0.5	< 0.5	< 0.5
Nivalenol	< 0.5	< 0.5	< 0.5	< 0.5
Zearalenone	< 0.5	< 0.5	< 0.5	< 0.5

[1] Diet samples were taken from the feeder at the beginning and the end of each phase, pooled, subsampled, and submitted for analysis (North Dakota State University, Veterinary Diagnostic Laboratory, Fargo, ND).

[2] Defusion (Provimi, Brooksville, OH) included at 0.25% in negative control diet at the expense of corn.

[3] Feed Aid (NutriQuest, Mason City, IA) included at 0.25% in negative control diet at the expense of corn.

[4] DON = deoxynivalenol.

Table 3. Effects of added Feed Aid or Defusion on finishing pig performance[1]

Item	Positive control[2]	Negative control[3]	Defusion[4]	Feed Aid[5]	SEM
d 0 to 28					
ADG, lb	1.44[a]	1.32[b]	1.34[ab]	1.28[b]	0.028
ADFI, lb	2.79[a]	2.59[b]	2.62[b]	2.52[b]	0.059
F/G	1.94	1.96	1.95	1.98	0.024
d 28 to 56					
ADG, lb	2.01[a]	1.80[c]	1.91[b]	1.89[b]	0.022
ADFI, lb	4.30	4.21	4.20	4.06	0.089
F/G	2.14[b]	2.35[a]	2.20[b]	2.15[b]	0.041
d 56 to 85					
ADG, lb	2.06	2.08	2.04	2.06	0.015
ADFI, lb	5.85	5.78	5.83	5.69	0.076
F/G	2.84	2.78	2.86	2.77	0.036
d 85 to 112					
ADG, lb	1.70	1.72	1.70	1.75	0.031
ADFI, lb	5.77	5.76	5.85	5.80	0.079
F/G	3.40	3.36	3.44	3.33	0.051
d 0 to 112					
ADG, lb	1.80[a]	1.73[b]	1.75[b]	1.74[b]	0.013
ADFI, lb	4.66	4.56	4.59	4.49	0.060
F/G	2.59	2.64	2.63	2.58	0.028
BW, lb					
d 0	45.1	45.1	45.1	45.1	0.861
d 28	85.6[a]	82.2[b]	82.9[ab]	80.9[b]	1.446
d 56	141.7[a]	132.5[b]	136.6[b]	133.9[b]	1.719
d 85	201.8[a]	193.4[b]	196.1[b]	194.0[b]	1.856
d 112	247.9[a]	239.1[b]	242.5[ab]	240.9[b]	1.818

[ab] Means within a row with different superscripts differ $P < 0.05$.

[1] A total of 1,188 pigs (PIC 337 × 1050, initially 45.1 lb BW) were used in a 112-d study with 27 pigs per pen and 11 replications per treatment. Experimental diets were fed from d 0 to 112.

[2] A corn-soybean meal-based diet.

[3] A corn-soybean meal-based diet containing 40% dried distillers grain.

[4] Defusion (Provimi, Brooksville, OH) included at 0.25% in negative control diet at the expense of corn.

[5] Feed Aid (NutriQuest, Mason City, IA) included at 0.25% in negative control diet at the expense of corn.