Effects of Lowering Dietary NDF Levels Prior to Marketing on Finishing Pig Growth Performance, Carcass Characteristics, Carcass Fat Quality, and Intestinal Weights[1]

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Summary

A total of 264 pigs (PIC 327 × 1050, initially 90.1 lb) were used in a 90-d study to determine the effects of withdrawal of high dietary NDF (provided by wheat middlings [midds] and dried distillers grains with solubles [DDGS]) on growth performance, carcass characteristics, carcass fat quality, and intestinal weights of growing-finishing pigs. Pens of pigs were randomly allotted by initial weight and gender to 1 of 6 dietary treatments with 6 replications per treatment. There were 24 pens with 7 pigs per pen (3 barrows and 4 gilts) and 12 pens with 8 pigs per pen (4 barrows and 4 gilts). A positive control diet containing no DDGS or midds and a negative control diet containing 30% DDGS and 19% midds was fed the entire study duration (no withdrawal). The other 4 treatments were arranged in a 2 × 2 factorial with the main effects of withdrawal time (23 or 47 d) and NDF level fed during the withdrawal (low or medium). Pigs on these treatments were fed the negative control diet containing 30% DDGS and 19% wheat midds (19% NDF) prior to their withdrawal treatment. The medium fiber withdrawal diet contained 15% DDGS and 9.5% midds (14.2% NDF). The low-fiber withdrawal diet was the positive control diet without DDGS or midds (9.3% NDF). Increasing the duration of the withdrawal lowered overall ADFI (linear, $P < 0.03$) and improved F/G (linear, $P < 0.004$); however, overall ADG was not affected. Withdrawing the high-fiber diet for the last 23 d did not influence ($P > 0.61$) growth performance. Withdrawing the high-fiber diet improved carcass yield ($P < 0.004$) with a greater response ($P < 0.001$) when the low-NDF diet was fed during the withdrawal instead of the medium NDF diet; however, increasing the withdrawal time from 23 to 47 d did not further improve yield ($P = 0.11$).

Jowl fat iodine value (IV) decreased as withdrawal time increased (linear, $P < 0.01$) and was lower ($P < 0.001$) for pigs fed the low-NDF diet during the withdrawal period than pigs fed the medium-NDF diet during withdrawal, but increasing the withdrawal time from 23 to 47 d further reduced ($P < 0.01$) jowl IV. Increasing the duration that the control diet was fed by extending the withdrawal time increased ($P < 0.01$) backfat depth and tended ($P < 0.11$) to decrease percentage lean. The length of the withdrawal time had minor effects on several organ weights, but the large intestine was the most influenced with a response similar to the yield response. Withdrawing the high-fiber diet decreased full large-intestine weight (linear, $P < 0.01$) with a greater response

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($P < 0.04$) when the low-NDF diet was fed during the withdrawal instead of the medium NDF diet; however, increasing the withdrawal time from 23 to 47 d did not further decrease ($P = 0.20$) large-intestine weights. Withdrawing pigs from a high-NDF diet containing DDGS and midds before market can improve F/G, carcass yield, and iodine value, and can reduce large intestine weight; however, the optimal length of withdrawal depends on the response criteria targeted.

Key words: DDGS, fiber, finishing pig, NDF, wheat middlings, withdrawal

Introduction

Feed ingredients such as wheat middlings (midds) and DDGS are often used as alternatives to corn and soybean meal in swine diets. Although these ingredients are used with the intent of lowering feed costs, they can negatively affect performance and carcass characteristics. Two areas of concern are the reduction in carcass yield with pigs fed high-fiber diets and the negative effect of DDGS on fat quality. Soft carcass fat with a high iodine value (IV) has consistently been observed in pigs fed high levels of DDGS. Reducing the level of DDGS in the diet prior to market has been successful in lowering IV and improving yield; however, more data are required to determine the length of time required and level of reduction needed to achieve desired endpoints for carcass weight and fat quality. More data are also required to determine the reasons why yield is reduced when feeding diets containing ingredients with high fiber content such as DDGS or midds.

Therefore, the objective of this trial was to determine the effects of decreasing or fully withdrawing NDF at different times prior to market on growth performance, carcass characteristics, and carcass fat quality of growing-finishing pigs.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the K-State Swine Teaching and Research Center in Manhattan, KS. The facility was a totally enclosed, environmentally regulated, mechanically ventilated barn containing 36 pens (8 × 10 ft). The pens had adjustable gates facing the alleyway that allowed for 10 ft^2/pig. Each pen was equipped with a cup waterer and a single-sided, dry self-feeder (Farmweld, Teutopolis, IL) with 2 eating spaces located in the fence line. Pens were located over a completely slatted concrete floor with a 4-ft pit underneath for manure storage. The facility was also equipped with a computerized feeding system (FeedPro; Feedlogic Corp., Willmar, MN) that delivered and recorded diets as specified. The equipment provided pigs with ad libitum access to food and water.

A total of 264 pigs (PIC 327 × 1050, initially 90.1 lb) were used in a 90-d trial. Pens of pigs (4 barrows and 4 gilts per pen or 3 barrows and 4 gilts per pen) were randomly allotted by initial weight to 1 of 6 dietary treatments with 6 replications per treatment. Treatments were arranged in a 2 × 2 factorial design plus 2 additional treatments with the main effects of withdrawal time (23 or 47 d) and dietary fiber (14.2 or 9.3% NDF). The additional treatments were a positive control diet containing no DDGS or midds (9.3% NDF) and a negative control diet containing 30% DDGS and 19% midds with

no withdrawal (19.0% NDF). Dietary treatments were corn-soybean meal-based and fed in 4 phases (Tables 1 and 2). All diets were fed in meal form.

Wheat middlings and DDGS samples were collected at the time of feed manufacture and a composite sample was analyzed (Table 3). Feed samples were also collected from each feeder during each phase and combined for a single composite sample by treatment for each phase to measure bulk density (Table 4). Bulk density of a material represents the mass per unit volume (pound per bushel).

Pigs and feeders were weighed approximately every 3 wk to calculate ADG, ADFI, and F/G. On d 90, all pigs were weighed individually, the second heaviest gilt in each pen (1 pig per pen, 6 pigs per treatment) was identified to be harvested at the K-State Meats Lab (KSU), and all others were then transported to Triumph Foods LLC, St. Joseph, MO. The pigs selected for harvest at K-State were blocked by treatment and randomly allotted to a harvest order to equalize the withdrawal time from feed before slaughter. Hot carcass weights were measured immediately after evisceration. Following evisceration, the entire pluck (heart, lungs, liver, kidneys, spleen, stomach, cecum, large intestine, small intestine, and reproductive tract) was weighed, then individual organs were weighed. After full organ weights were recorded, the large intestine, stomach, and cecum were physically stripped of contents and reweighed, then flushed with water, physically stripped of contents, and weighed again. For pigs harvested at the commercial packing plant, pigs were individually tattooed in sequential order by pen and gender to allow for carcass data collection at the packing plant and data retrieval by pen. Hot carcass weights were measured immediately after evisceration and each carcass was evaluated for percentage yield, backfat, loin depth, and percentage lean. Because there were differences in HCW, it was used as a covariate for backfat, loin depth, and percentage lean. Also, jowl fat samples were collected and analyzed by Near Infrared Spectroscopy (NIR) at the plant for IV. Percentage yield was calculated by dividing HCW at the plant by live weight at the farm before transport to the plant.

Data were analyzed as a completely randomized design using the PROC MIXED procedure of SAS (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. The main effects of the different withdrawal regimens of NDF level and withdrawal time were tested. Linear and quadratic contrasts were used to determine the effects of withdrawal time and NDF levels. These contrast coefficients were adjusted for unequally spaced withdrawal times. Differences between treatments were determined by using least squares means. Results were considered significant at $P \leq 0.05$ and considered a trend at $P \leq 0.10$.

Results and Discussion

Bulk density tests showed that adding dietary NDF dramatically decreased diet bulk density (Table 4).

Withdrawal treatments did not influence ($P > 0.36$) overall ADG; however, because pigs switched from the high-fiber diets on d 43 (47 d before market) grew numerically faster from d 43 to 67, there was a quadratic response ($P < 0.04$) for the duration of withdrawal from d 43 to 67 and 43 to 90 and for NDF level fed from d 43 to 67 (Tables 5 and 6). Overall ADFI was reduced ($P < 0.03$) and F/G improved ($P < 0.004$)

as duration of withdrawal increased due to reductions in ADFI from d 43 to 67 and 67 to 90 for pigs fed the high-energy (lower fiber) diets from d 43 to 90. Interestingly, lowering the NDF level by using the withdraw diets for only 23 d before market did not alter ($P > 0.61$) ADFI or F/G.

Withdrawing the high-NDF diet improved carcass yield ($P < 0.004$) with a greater response ($P < 0.001$) when the low-NDF diet was fed during the withdrawal instead of the medium NDF diet; however, increasing the withdrawal time from 23 to 47 d did not further improve yield ($P = 0.11$) (Tables 7 and 8). Jowl fat iodine value (IV) decreased as withdrawal time increased (linear, $P < 0.01$) and was lower ($P < 0.001$) for pigs fed the low-NDF diet during the withdrawal period than pigs fed the medium-NDF diet during withdrawal, but increasing the withdrawal time from 23 to 47 d further reduced ($P < 0.01$) jowl IV. Increasing the duration of feeding the low-NDF diets by extending the withdrawal time increased ($P = 0.01$) backfat depth and tended ($P = 0.11$) to decrease percentage lean.

The NDF level fed and duration of withdrawal had minor effects on most organ weights except the digestive tract, which, as expected, was most influenced by NDF levels. Withdrawing the high-NDF diet for the last 47 d actually increased ($P = 0.03$) small-intestine weight whether calculated on a weight basis (Tables 9 and 10) or percentage of live weight basis (Tables 11 and 12). Stomach weights were not influenced by feeding duration other than a tendency ($P < 0.06$) for stripped stomach weight to be decreased as duration of withdrawal increased. Similarly, the influence of withdrawal treatments on cecum weights was minor, with only small reductions ($P < 0.08$) in full, stripped, and rinsed cecum weights when the low NDF level was fed during the withdrawal period instead of the medium NDF level. The greatest impact of withdrawal treatments was on large-intestine weights, with a response similar to the yield response. Increasing duration of withdrawal decreased (linear, $P < 0.05$) full and stripped large intestine weights. As NDF level increased in the diet from d 43 to 67 or 67 to 90, full and stripped large intestine weights also increased ($P < 0.04$), with pigs fed the low-NDF diet during the withdrawal period also having lower ($P < 0.04$) full large intestine weight than those fed the medium-NDF diet.

For the other organs, as the duration of withdrawal increased, there was a reduction (quadratic, $P < 0.02$) in spleen weight and a tendency ($P < 0.11$) for a reduction when NDF was reduced 47 d prior to market; however, no other differences were identified ($P > 0.47$) in spleen weight. As fiber was withdrawn 47 d prior to market, there was a reduction (quadratic, $P < 0.01$) in kidney weight, with a reduction ($P < 0.03$) in pigs fed the low-NDF diets compared with the medium-NDF diets during withdrawal. Heart, lungs, liver, and reproductive tract weights were not influenced ($P > 0.10$) by NDF level or withdrawal treatments.

In summary, withdrawing pigs from a high-NDF diet containing DDGS and midds before market can improve F/G, carcass yield, IV, and reduce large intestine weight, but the optimal length of withdrawal depends on the response criteria being targeted.

Table 1. Phase 1 and 2 diet composition (as-fed basis)[1]

	Phase 1		Phase 2	
NDF, %:	9.3	19.0	9.3	19.0
ADF, %:	3.3	6.7	3.2	6.6
Wheat midds, %:	0	30	0	30
Item %:	0	19	0	19
Ingredient, %				
Corn	73.70	34.90	78.95	40.00
Soybean meal (46.5% CP)	23.80	13.75	18.85	8.70
DDGS[2]	---	30.00	---	30.00
Wheat middlings	---	19.00	---	19.00
Monocalcium P, (21% P)	0.45	---	0.35	---
Limestone	1.05	1.30	1.00	1.28
Salt	0.35	0.35	0.35	0.35
Vitamin premix	0.15	0.15	0.13	0.13
Trace mineral premix	0.15	0.15	0.13	0.13
L-Lysine HCl	0.17	0.31	0.15	0.29
DL-Methionine	0.02	---	---	---
L-Threonine	0.03	---	0.01	---
Phytase[3]	0.13	0.13	0.13	0.13
Total	100.0	100.0	100.0	100.0
Crude fiber, %	2.5	4.9	2.5	4.9
Standardized ileal digestible (SID) amino acids, %				
Lysine	0.93	0.93	0.79	0.79
Isoleucine:lysine	69	72	70	74
Leucine:lysine	156	188	169	206
Methionine:lysine	30	34	30	37
Met & Cys:lysine	59	70	62	77
Threonine:lysine	63	66	63	69
Tryptophan:lysine	19	19	19	19
Valine:lysine	78	88	81	94
SID lysine:ME/Mcal	2.79	2.84	2.36	2.41
ME, kcal/lb	1,513	1,484	1,516	1,486
Total lysine, %	1.04	1.09	0.89	0.94
CP, %	17.52	20.83	15.62	18.91
Ca, %	0.59	0.58	0.53	0.56
P, %	0.47	0.58	0.42	0.56
Available P, %	0.27	0.39	0.25	0.38

[1] Phase 1 diets were fed from approximately 90 to 130 lb; Phase 2 diets were fed from 130 to 180 lb.
[2] Dried distillers grains with solubles.
[3] Phyzyme 600 (Danisco Animal Nutrition, St Louis MO) provided per pound of diet: 353.8 FTU/lb and 0.11% available P released.

Table 2. Phase 3 and 4 diet composition (as-fed basis)[1]

	Phase 3			Phase 4		
NDF, %:	9.3	14.2	19.0	9.3	14.2	19.0
ADF, %:	3.1	4.8	6.5	3.1	4.8	6.5
Wheat midds, %:	0	9.5	19.0	0	9.5	19.0
Item DDGS[2], %:	0	15.0	30.0	0	15.0	30.0
Ingredient, %						
Corn	82.65	63.30	43.55	84.95	65.60	45.80
Soybean meal, (46.5%)	15.30	10.20	5.20	13.15	8.05	3.05
DDGS	---	15.00	30.00	---	15.00	30.00
Wheat middlings	---	9.50	19.00	---	9.50	19.00
Monocalcium P, (21% P)	0.25	---	---	0.20	---	---
Limestone	0.98	1.10	1.29	0.93	1.05	1.28
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.10	0.10	0.10	0.08	0.08	0.08
Trace mineral premix	0.10	0.10	0.10	0.08	0.08	0.08
L-Lysine HCl	0.14	0.21	0.28	0.13	0.20	0.27
Phytase[3]	0.13	0.13	0.13	0.13	0.13	0.13
Total	100.0	100.0	100.0	100.0	100.0	100.0
Crude fiber, %	2.4	3.6	4.8	2.4	3.6	4.8
Standardized ileal digestible (SID) amino acid, %						
Lysine	0.69	0.69	0.69	0.63	0.63	0.63
Isoleucine:lysine	72	74	76	73	75	78
Leucine:lysine	181	203	224	191	214	238
Methionine:lysine	32	36	40	33	38	43
Met & Cys:lysine	66	74	83	69	78	88
Threonine:lysine	64	68	72	66	70	74
Tryptophan:lysine	19	19	19	19	19	19
Valine:lysine	85	92	99	87	95	103
SID lysine:ME/Mcal	2.06	2.08	2.10	1.88	1.90	1.92
ME, kcal/lb	1,520	1,506	1,487	1,522	1,508	1,488
Total lysine, %	0.78	0.81	0.83	0.72	0.74	0.77
CP, %	14.28	15.92	17.57	13.46	15.1	16.75
Ca, %	0.49	0.49	0.55	0.46	0.46	0.54
P, %	0.39	0.44	0.55	0.37	0.43	0.54
Available P, %	0.22	0.27	0.38	0.21	0.27	0.37

[1] Phase 3 diets were fed from approximately 180 to 203 lb; Phase 4 diets were fed from 230 to 270 lb.
[2] Dried distillers grains with solubles.
[3] Phyzyme 600 (Danisco Animal Nutrition, St Louis, MO) provided per pound of diet: 353.8 FTU/lb and 0.11% available P released.

Table 3. Chemical analysis of dried distillers grains with solubles (DDGS) and wheat middlings (as-fed basis)

Item	DDGS	Wheat middlings
Nutrient,%		
DM	90.2	88.8
CP	24.3 (27.2)[1]	16.6 (15.9)
Fat (oil)	12.3	4.0
Crude Fiber	6.0 (7.7)	7.9 (7.0)
ADF	10.6 (9.9)	10.3 (10.7)
NDF	36.1 (25.3)	36.6 (35.6)
Ash	4.3	5.7

[1] Values in parentheses indicate those used in diet formulation.

Table 4. Bulk density of experimental diets (as-fed basis)[1]

	Treatments		
NDF, %:	9.3	14.2	19.0
Wheat midds,%:	0	9.5	19.0
Bulk density, lb/bu[1,2] DDGS[3],%:	0	15.0	30.0
Phase 1	50.7	---	37.9
Phase 2	52.0	---	37.9
Phase 3	50.3	47.3	40.0
Phase 4	49.4	42.5	38.3

[1] Diet samples collected from the tops of each feeder during each phase.
[2] Phase 1 was d 0 to d 20; Phase 2 was d 20 to d 43; Phase 3 was d 43 to d 67; Phase 4 was d 67 to d 90.
[3] Dried distillers grains with solubles.

Table 5. Effect of dietary NDF level prior to marketing on finishing pig growth performance[1]

Treatment:	1	2	3	4	5	6	
d 0 to 43:	Low[2]	High[3]	High	High	High	High	
d 43 to 67:	Low	Low	Med[4]	High	High	High	
d 67 to 90:	Low	Low	Med	Low	Med	High	SEM
Weight, lb							
d 0	90.1	90.3	90.1	90.2	90.0	90.3	1.78
d 20	134.9	133.5	133.6	133.9	133.1	133.5	2.16
d 43	179.7	177.1	177.2	177.5	177.5	177.5	2.99
d 67	222.5	223.5	225.5	222.8	222.6	223.4	2.88
d 90	265.4	268.5	270.1	268.1	267.3	267.4	3.09
d 0 to 43							
ADG, lb	2.08	2.02	2.02	2.02	2.02	2.02	0.04
ADFI, lb	5.30	5.33	5.25	5.33	5.32	5.34	0.10
F/G	2.55	2.64	2.60	2.64	2.63	2.64	0.04
d 43 to 67							
ADG, lb	1.78	1.93	2.01	1.88	1.88	1.91	0.03
ADFI, lb	5.81	6.14	6.28	6.28	6.28	6.31	0.14
F/G	3.26	3.18	3.12	3.34	3.34	3.30	0.07
d 67 to 90							
ADG, lb	1.86	1.95	1.93	1.97	1.94	1.92	0.05
ADFI, lb	6.16	6.23	6.47	6.63	6.67	6.72	0.12
F/G	3.31	3.20	3.36	3.37	3.43	3.51	0.08
d 43 to 90							
ADG, lb	1.82	1.94	1.97	1.93	1.91	1.91	0.03
ADFI, lb	5.99	6.18	6.37	6.45	6.47	6.51	0.13
F/G	3.28	3.19	3.24	3.35	3.38	3.41	0.06
d 0 to 90							
ADG, lb	1.95	1.98	1.99	1.97	1.97	1.97	0.02
ADFI, lb	5.65	5.77	5.82	5.91	5.91	5.95	0.10
F/G	2.90	2.92	2.92	3.00	3.00	3.02	0.03

[1] A total of 264 pigs (PIC 327 × 1050, initial BW= 90.1 lb) were used in this 90-d study.
[2] Refers to diet with 0% dried distillers grains with solubles (DDGS) and 0% midds with NDF of 9.3%.
[3] Refers to diet with 30% DDGS and 19.0% midds with NDF of 19.0%.
[4] Refers to diet with 15% DDGS and 9.5% midds with NDF of 14.2%.

Table 6. Main effects of dietary NDF level prior to marketing on finishing pig growth performance[1]

	Probability, *P* <						
	Withdrawal duration[2]		Fiber level, d 43 to 90[3]		Fiber level, d 67 to 90[4]		Fiber level during withdrawal[5]
	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic	
Weight, lb							
d 0	0.96	0.97	0.99	0.92	0.96	0.91	
d 20	0.63	0.75	0.98	0.98	0.91	0.82	
d 43	0.59	0.66	0.92	0.98	1.00	0.99	
d 67	0.90	0.74	0.98	0.57	0.89	0.89	
d 90	0.64	0.43	0.81	0.58	0.89	0.90	
d 0 to 43							
ADG, lb	0.20	0.33	0.92	0.93	0.91	0.98	
ADFI, lb	0.75	0.79	0.92	0.49	0.94	0.89	
F/G	0.05	0.42	1.00	0.38	0.99	0.83	
d 43 to 67							
ADG, lb	0.02	0.008	0.64	0.04	0.59	0.66	
ADFI, lb	0.01	0.29	0.42	0.75	0.91	0.92	
F/G	0.41	0.30	0.23	0.20	0.69	0.87	
d 67 to 90							
ADG, lb	0.30	0.24	0.65	0.92	0.45	1.00	
ADFI, lb	0.001	0.81	0.008	0.99	0.63	0.98	
F/G	0.06	0.14	0.007	0.95	0.21	0.92	
d 43 to 90							
ADG, lb	0.04	0.02	0.56	0.28	0.79	0.82	0.82
ADFI, lb	0.003	0.61	0.07	0.86	0.76	0.94	0.42
F/G	0.09	0.10	0.01	0.41	0.54	0.96	0.51
d 0 to 90							
ADG, lb	0.65	0.36	0.76	0.47	0.91	0.90	0.83
ADFI, lb	0.03	0.86	0.22	0.74	0.82	0.86	0.83
F/G	0.004	0.45	0.03	0.19	0.61	0.85	0.96

[1] A total of 264 pigs (PIC 327 × 1050, initial BW= 90.1 lb) were used in an 87-d study.
[2] Effect of duration of withdrawal regardless of fiber level fed during withdrawal.
[3] Effect of fiber level (19%, 14.2%, 9.3%) fed from d 43 to 90 (last 47 d before market; treatments 2, 3, and 6).
[4] Effect of fiber level (19%, 14.2%, 9.3%) fed from d 67 to 90 (last 23 d before market; treatments 4, 5, and 6).
[5] Effect of fiber level (14.2% vs. 9.3%) regardless of time of withdrawal (treatments 2 and 4 vs. 3 and 5).

Table 7. Effect of dietary NDF level prior to marketing on finishing pig carcass characteristics[1]

	Treatment						
	1	2	3	4	5	6	
d 0 to 43:	Low[2]	High[3]	High	High	High	High	
d 43 to 67:	Low	Low	Med[4]	High	High	High	
d 67 to 90:	Low	Low	Med	Low	Med	High	SEM
Carcass yield, %[5]	73.2	72.9	71.6	73.0	72.4	71.7	0.26
HCW, lb	194.3	195.8	193.7	195.5	193.5	191.4	2.54
Backfat depth, in.[6]	0.74	0.73	0.69	0.72	0.75	0.66	0.02
Loin depth, in.[6]	2.30	2.35	2.31	2.33	2.25	2.33	0.04
Lean, %[6]	53.0	53.4	53.6	53.3	52.7	53.9	0.31
Jowl iodine value	68.4	70.6	75.8	74.8	76.6	78.5	0.94

[1] A total of 264 pigs (PIC 327 × 1050, initial BW= 90.1 lb) were used in this 90-d trial.
[2] Refers to diet with 0% dried distillers grains with solubles (DDGS) and 0% midds with NDF of 9.3%.
[3] Refers to diet with 30% DDGS and 19% midds with NDF of 19%.
[4] Refers to diet with 15% DDGS and 9.5% midds with NDF of 14.2%.
[5] Percentage yield was calculated by dividing HCW by live weight obtained at the farm before transport to the packing plant.
[6] Adjusted by using HCW as a covariate.

Table 8. Main effects of dietary NDF level prior to marketing on finishing pig carcass characteristics[1]

	Probability, *P* <						
	Withdrawal duration[2]		Fiber level, d 43 to 90[3]		Fiber level, d 67 to 90[4]		Fiber level during withdrawal[5]
	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic	
Carcass yield, %[6]	0.002	0.85	0.004	0.03	0.002	0.97	<0.001
HCW, lb	0.49	0.38	0.23	0.98	0.26	0.98	0.43
Backfat depth, in.[7]	0.01	0.22	0.02	0.80	0.03	0.02	0.74
Loin depth, in.[7]	0.71	0.94	0.74	0.46	0.95	0.12	0.14
Lean, %[7]	0.11	0.45	0.27	0.73	0.18	0.02	0.46
Jowl iodine value	<0.001	0.91	<0.001	0.27	0.01	0.94	<0.001

[1] A total of 264 pigs (PIC 327 × 1050, initial BW= 90.1 lb) were used in an 87-d study.
[2] Effect of duration of withdrawal regardless of fiber level fed during withdrawal.
[3] Effect of fiber level (19%, 14.2%, 9.3%) fed from d 43 to 90 (last 47 d before market; treatments 2, 3, and 6).
[4] Effect of fiber level (19%, 14.2%, 9.3%) fed from d 67 to 90 (last 23 d before market; treatments 4, 5, and 6).
[5] Effect of fiber level (14.2% vs. 9.3%) regardless of time of withdrawal (treatments 2 and 4 vs. 3 and 5).
[6] Percentage yield was calculated by dividing HCW by live weight obtained at the farm before transport to the packing plant.
[7] Adjusted by using HCW as a covariate.

Table 9. Effect of dietary NDF level prior to marketing on finishing pig intestinal and organ weights, lb[1]

	Treatment						
	1	2	3	4	5	6	
d 0 to 43:	Low[2]	High[3]	High	High	High	High	
d 43 to 67:	Low	Low	Med[4]	High	High	High	
d 67 to 90:	Low	Low	Med	Low	Med	High	SEM
Full pluck	26.71	28.30	28.63	27.34	27.93	28.75	0.90
Whole intestine	16.55	17.66	18.41	16.83	17.65	18.59	0.70
Stomach							
Full	1.91	2.17	2.17	2.24	2.10	2.10	0.16
Stripped	1.38	1.47	1.47	1.48	1.45	1.50	0.05
Rinsed	1.38	1.38	1.38	1.41	1.40	1.44	0.05
Cecum							
Full	1.58	1.28	1.89	1.50	1.63	1.70	0.19
Stripped	0.58	0.54	0.61	0.52	0.56	0.56	0.03
Rinsed	0.54	0.51	0.56	0.50	0.56	0.54	0.03
Large intestine							
Full	6.57	7.11	8.18	6.69	7.48	8.68	0.46
Stripped	3.38	3.39	3.65	3.25	3.41	3.93	0.17
Rinsed	3.17	3.23	3.42	3.07	3.20	3.57	0.14
Small intestine							
Full	6.04	6.81	6.06	5.64	6.07	5.87	0.29
Heart	1.00	0.93	0.93	0.93	0.94	0.93	0.03
Lungs	1.34	1.40	1.23	1.23	1.36	1.31	0.06
Liver	3.91	3.96	3.82	3.98	3.87	4.22	0.13
Kidneys	0.80	0.81	0.93	0.82	0.86	0.85	0.04
Spleen	0.37	0.44	0.48	0.44	0.43	0.42	0.03
Reproductive tract	1.21	1.33	1.18	1.25	1.15	1.19	0.17

[1] A total of 264 pigs (PIC 327 × 1050, initial BW= 90.1 lb) were used in this 90-d trial.
[2] Refers to diet with 0% dried distillers grains with solubles (DDGS) and 0% midds with NDF of 9.3%.
[3] Refers to diet with 30% DDGS and 19% midds with NDF of 19%.
[4] Refers to diet with 15% DDGS and 9.5% midds with NDF of 14.2%.

Table 10. Main effects of dietary NDF level prior to marketing on finishing pig intestinal and organ weights, lb[1]

	Probability, *P* <						
	Withdrawal duration[2]		Fiber level d 43 to 90[3]		Fiber level d 67 to 90[4]		Fiber level during withdrawal[5]
	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic	
Full pluck	0.16	0.71	0.74	0.92	0.28	0.91	0.62
Whole intestine	0.08	0.94	0.36	0.74	0.09	0.95	0.27
Stomach							
Full	0.32	0.28	0.76	0.86	0.52	0.71	0.65
Stripped	0.12	0.74	0.66	0.80	0.74	0.57	0.81
Rinsed	0.36	0.58	0.36	0.69	0.65	0.69	1.00
Cecum							
Full	0.73	0.69	0.13	0.12	0.46	0.89	0.07
Stripped	0.38	0.79	0.70	0.12	0.33	0.57	0.08
Rinsed	0.93	0.68	0.39	0.32	0.28	0.26	0.05
Large intestine							
Full	0.008	0.44	0.02	0.61	0.005	0.72	0.05
Stripped	0.07	0.11	0.03	0.95	0.007	0.38	0.22
Rinsed	0.13	0.29	0.11	0.92	0.02	0.51	0.27
Small intestine							
Full	0.50	0.26	0.03	0.43	0.58	0.38	0.58
Heart	0.07	0.38	0.91	0.87	0.84	0.73	0.85
Lungs	0.65	0.78	0.34	0.12	0.42	0.28	0.71
Liver	0.15	0.13	0.18	0.10	0.22	0.16	0.33
Kidneys	0.39	0.36	0.44	0.03	0.53	0.59	0.03
Spleen	0.19	0.03	0.54	0.13	0.54	0.90	0.66
Reproductive tract	0.92	0.82	0.58	0.69	0.81	0.73	0.47

[1] A total of 264 pigs (PIC 327 × 1050, initial BW= 90.1 lb) were used in an 87-d study.
[2] Effect of duration of withdrawal regardless of fiber level fed during withdrawal.
[3] Effect of fiber level (19%, 14.2%, 9.3%) fed from d 43 to 90 (last 47 d before market; treatments 2, 3, and 6).
[4] Effect of fiber level (19%, 14.2%, 9.3%) fed from d 67 to 90 (last 23 d before market; treatments 4, 5, and 6).
[5] Effect of fiber level (14.2% vs. 9.3%) regardless of time of withdrawal (treatments 2 and 4 vs. 3 and 5).

Table 11. Effect of dietary NDF levels prior to marketing on finishing pig intestinal and organ weights, %[1, 2]

Treatment:	1	2	3	4	5	6	
d 0 to 43:	Low[3]	High[4]	High	High	High	High	
d 43 to 67:	Low	Low	Med[5]	High	High	High	
d 67 to 90:	Low	Low	Med	Low	Med	High	SEM
Full pluck	9.83	10.75	10.77	10.29	10.57	10.70	0.30
Whole intestine	6.09	6.64	6.92	6.33	6.69	6.92	0.25
Stomach							
Full	0.70	0.82	0.81	0.84	0.79	0.78	0.05
Stripped	0.51	0.55	0.55	0.55	0.55	0.56	0.02
Rinsed	0.51	0.52	0.52	0.53	0.53	0.54	0.02
Cecum							
Full	0.58	0.49	0.72	0.57	0.62	0.63	0.07
Stripped	0.21	0.20	0.23	0.19	0.21	0.21	0.01
Rinsed	0.20	0.19	0.21	0.19	0.21	0.20	0.01
Large intestine							
Full	2.42	2.67	3.07	2.52	2.84	3.23	0.17
Stripped	1.25	1.27	1.37	1.22	1.29	1.47	0.06
Rinsed	1.17	1.21	1.28	1.15	1.21	1.33	0.05
Small intestine							
Full	2.22	2.56	2.28	2.12	2.29	2.18	0.10
Heart	0.37	0.35	0.35	0.35	0.36	0.34	0.01
Lungs	0.49	0.53	0.46	0.46	0.51	0.49	0.02
Liver	1.44	1.48	1.43	1.50	1.47	1.57	0.05
Kidneys	0.29	0.30	0.35	0.31	0.32	0.32	0.01
Spleen	0.14	0.17	0.18	0.17	0.16	0.16	0.01
Reproductive tract	0.44	0.50	0.44	0.47	0.43	0.44	0.06

[1] A total of 264 pigs (PIC 327 × 1050, initial BW= 90.1 lb) were used in this 90-d trial.
[2] All values are a percentage of live weight; i.e., (reproductive tract/live weight) × 100.
[3] Refers to diet with 0% DDGS and 0% midds with NDF of 9.3%.
[4] Refers to diet with 30% DDGS and 19% midds with NDF of 19%.
[5] Refers to diet with 15% DDGS and 9.5% midds with NDF of 14.2%.

Table 12. Main effects of dietary NDF levels prior to marketing on finishing pig intestinal and organ weights, %[1]

	Probability, *P* <						
	Withdrawal duration[2]		Fiber level, d 43 to 90[3]		Fiber level, d 67 to 90[4]		Fiber level during withdrawal[5]
	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic	
Full pluck	0.06	0.25	0.92	0.91	0.34	0.85	0.63
Whole intestine	0.04	0.58	0.45	0.65	0.11	0.83	0.21
Stomach							
Full	0.24	0.16	0.63	0.81	0.43	0.78	0.63
Stripped	0.06	0.40	0.79	0.89	0.90	0.77	0.91
Rinsed	0.19	0.94	0.42	0.78	0.79	0.92	0.88
Cecum							
Full	0.66	0.84	0.16	0.11	0.51	0.82	0.07
Stripped	0.55	0.93	0.77	0.10	0.39	0.45	0.07
Rinsed	0.85	1.00	0.46	0.28	0.37	0.18	0.04
Large intestine							
Full	0.01	0.62	0.03	0.57	0.006	0.88	0.04
Stripped	0.05	0.21	0.04	0.97	0.009	0.50	0.18
Rinsed	0.07	0.48	0.12	0.83	0.02	0.65	0.20
Small intestine							
Full	0.61	0.11	0.01	0.47	0.68	0.27	0.58
Heart	0.16	0.81	0.66	0.86	0.68	0.51	0.85
Lungs	0.82	0.87	0.19	0.08	0.45	0.18	0.63
Liver	0.06	0.24	0.18	0.10	0.26	0.22	0.37
Kidneys	0.23	0.16	0.45	0.01	0.62	0.44	0.02
Spleen	0.16	0.02	0.49	0.11	0.47	0.99	0.62
Reproductive tract	0.99	0.71	0.53	0.69	0.76	0.71	0.43

[1] A total of 264 pigs (PIC 327 × 1050, initial BW= 90.1 lb) were used in an 87-d study.
[2] Effect of duration of withdrawal regardless of fiber level fed during withdrawal.
[3] Effect of fiber level (19%, 14.2%, 9.3%) fed from d 43 to 90 (last 47 d before market; treatments 2, 3, and 6).
[4] Effect of fiber level (19%, 14.2%, 9.3%) fed from d 67 to 90 (last 23 d before market; treatments 4, 5, and 6).
[5] Effect of fiber level (14.2% vs. 9.3%) regardless of time of withdrawal (treatments 2 and 4 vs. 3 and 5).