Effects of Feeder Design, Gender, and Dietary Concentration of Dried Distillers Grains with Solubles on the Growth Performance and Carcass Characteristics of Growing-Finishing Pigs[1]

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Summary

A 2 × 2 × 2 factorial experiment was conducted to evaluate the interactive effects of feeder design (conventional dry vs. wet-dry feeder), gender (barrow vs. gilt), and dietary concentration of dried distillers grains with solubles (DDGS; 20% vs. 60%) on finishing pig performance. A total of 1,080 pigs (PIC 337 × 1050) were used in the 99-d experiment. Pigs were sorted by gender (barrows and gilts) into groups of 27, weighed (77.4 lb initial BW), allotted to pens containing 1 of the 2 feeder types, and assigned to a corn-soybean meal-DDGS-based feeding program of either 20% or 60% DDGS. A completely randomized design was used to evaluate the 8 treatment combinations, with 5 pens per treatment. This provided 20 pens per treatment for each of the three main effects (feeder type, gender, and DDGS concentration). All pigs were fed their assigned level of DDGS in 3 dietary phases (d 0 to 28, 28 to 56, and 56 to 78). On d 78, 2 pigs per pen were weighed and harvested. Jowl fat samples were collected from these pigs for fatty acid analysis and iodine value (IV). All remaining pigs were fed a common diet from d 78 to 99 that contained 20% DDGS and 4.5 g/ton of ractopamine HCl (Paylean; Elanco Animal Health, Indianapolis, IN). On d 99, all remaining pigs were harvested and carcass data were obtained from 885 pigs. Jowl fat samples were collected from 2 pigs per pen for fatty acid analysis and IV. Overall (d 0 to 99), pigs using the wet-dry feeder had greater ($P < 0.001$) ADG, ADFI, F/G, final BW, feed cost per pig, HCW, and backfat depth but decreased ($P < 0.05$) fat-free lean, jowl fat IV, premium per pig, value per cwt live, and net income per pig. Feeding 60% DDGS from d 0 to 78 resulted in decreased ($P < 0.02$) ADG, final BW, feed cost per pig, HCW, and backfat depth but increased ($P < 0.05$) F/G, fat-free lean, jowl fat IV, and net income per pig. Barrows had greater ($P < 0.01$) ADG, ADFI, F/G, final BW, feed cost per pig, HCW, and backfat depth but reduced fat-free lean, jowl fat IV, premium per pig, value per cwt live, and net income per pig. In conclusion, the greatest net income per pig resulted from feeding gilts 60% DDGS from d 0 to 78 and 20% DDGS with Paylean from d 78 to 99 using a conventional dry feeder. However, using wet-dry feeders improved ADG and ADFI of growing-finishing pigs and may improve the performance of slower growing populations within a group (e.g., gilts). Wet-dry feeders may also restore the growth rates of pigs fed adverse levels of DDGS. More research with wet-dry feeders is needed to resolve concerns with F/G, carcass leanness, and economic returns.

Key words: dried distillers grains with solubles, feeders

[1] Appreciation is expressed to New Horizon Farms for use of pigs and facilities and to Richard Brobjorg, Scott Heidebrink, and Mary Heintz for technical assistance.

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Introduction

Because finishing feed costs represent a significant proportion of the cost of production, swine producers are continually evaluating technologies that may improve the growth performance of finishing pigs and income over feed cost. Considerable improvements in growth and efficiency have been made in the areas of genetics and nutrition. However, studies that improve our understanding of various feeder types and their effects on performance, feeding behavior, and efficiency are scarce.

Currently, commercial growing-finishing barns are equipped with various types of feeders and waterers designed to provide pigs with ad libitum access to feed and water while attempting to minimize waste. Feed is often presented to pigs in its original, dry form with water provided separately in a nipple waterer, cup waterer, or water trough located in close proximity. However, some barns are equipped with wet-dry feeders, and these types of feeders are becoming increasingly common.

With a wet-dry feeder, the water source is located in the feed pan, giving pigs access to dry feed and water in the same location and the opportunity to consume wet feed. Previous research at Kansas State University (Rantanen et al., 1998[3]; Amornthewaphat et al., 2000[4]; Bergstrom et al., 2008[5]) has consistently demonstrated that using a wet-dry feeder improves the growth rate of finishing pigs. These previous studies evaluated the differences between a wet-dry feeder and a dry feeder with water provided separately. However, more studies comparing the effects of various feeder designs on the growth performance and carcass characteristics of finishing pigs in commercial facilities are needed.

The increasing costs of traditional feed ingredients coupled with the increased availability of dried distillers grains with solubles (DDGS) and other coproducts of the ethanol industry has resulted in an increase in the use of alternative feed ingredients. Research in recent years indicates that up to 20% DDGS may be included in diets for growing-finishing without reducing performance. Feeding more than 20% DDGS may result in reduced feed intake and growth performance, and pork fat quality may become unacceptable for some market outlets. Feeding pigs with a wet-dry feeder could overcome some of the negative aspects of feeding higher levels of alternative ingredients, giving swine producers more flexibility with ingredient selection.

Variation in the growth rates of individual pigs within a group reduces the efficiency of facility utilization in pork production. Normal biological variation results from individual differences in gender, genetics, health, birth weight, BW at placement, social status within the group, and nutritional status and requirements. Typically, gilts and barrows are fed a different feed budget during the growing and finishing period because gilts generally have lower ADG, ADFI, and F/G; are leaner; and therefore have different nutrient requirements. Using a wet-dry feeder for gilts could be more beneficial than for barrows and may improve the ability to manage within-group variation to achieve greater economic benefit.

[3] Rantanen et al., Swine Day 1995, Report of Progress 746, pp. 119-120.
[4] Amornthewaphat et al., Swine Day 2000, Report of Progress 858, pp. 123-131.
[5] Bergstrom et al., Swine Day 2008, Report of Progress 1001, pp. 196-203.

Therefore, the objective of this research was to determine if wet-dry feeders would improve the performance and profitability of barrows and gilts housed in commercial conditions and fed diets containing 20% or 60% DDGS.

Procedures

Procedures used in the experiment were approved by the Kansas State University Institutional Animal Care and Use Committee. The experiment was conducted in a commercial research finishing facility in southwestern Minnesota. The facility was double curtain sided with pit fans for minimum ventilation and completely slatted flooring over a deep pit for manure storage. Individual pens were 10 × 18 ft. Half of the pens were equipped with a single 60-in.-wide 5-hole conventional dry feeder (STACO, Inc., Schaefferstown, PA) and a single cup waterer in each pen (Figure 1). The remaining pens were each equipped with a double-sided wet-dry feeder (Crystal Springs, GroMaster, Inc., Omaha, NE) with a 15-in. feeder opening on both sides that provided access to feed and water (Figure 2). All pens that were equipped with a wet-dry feeder contained a cup waterer; however, these waterers were shut off during the experiment. Therefore, the only source of water for pigs in these pens was through the wet-dry feeder.

A total of 1,080 pigs (PIC 337 × 1050) were used in a 99-d experiment. A 2 × 2 × 2 factorial arrangement of treatments was used to evaluate the interactive effects of feeder design (conventional dry vs. wet-dry feeder), gender (barrow vs. gilt), and dietary concentration of DDGS (20% vs. 60%) on finishing pig performance. Pigs were sorted by gender (barrows and gilts) into groups of 27, weighed (77.4 lb initial BW), allotted to pens containing 1 of the 2 feeder types, and assigned to a corn-soybean meal-DDGS-based feeding program of either 20% or 60% DDGS (Table 1). A completely randomized design was used to evaluate the 8 treatment combinations, with 5 pens per treatment. This provided 20 pens per treatment for each of the 3 main effects (feeder type, gender, and DDGS concentration). All pigs were fed their assigned level of DDGS in 3 dietary phases (d 0 to 28, 28 to 56, and 56 to 78). On d 78, the 2 largest pigs in each pen were weighed and removed for harvest. Jowl fat samples were collected from these pigs for fatty acid analysis and iodine value (IV). All remaining pigs were fed a common diet from d 78 to 99 that contained 20% DDGS and 4.5 g/ton of ractopamine HCl (Paylean; Elanco Animal Health, Indianapolis, IN). On d 99, all remaining pigs were harvested and carcass data were obtained from 885 pigs. Jowl fat samples were collected from the carcasses of 2 average-sized pigs within each pen for fatty acid analysis and IV. This experiment was conducted from Aug. 8 to Nov. 12, 2008.

Data were analyzed as 2 × 2 × 2 factorial arrangement in a completely randomized design using the PROC MIXED procedure of SAS (SAS Institute Inc., Cary, NC). Pen was the experimental unit. Because there were differences in the initial BW of barrows and gilts, the initial BW was used as a covariate in data analysis.

Results

From d 0 to 78 (Table 2), feeder design × DDGS ($P < 0.05$) and feeder design × gender ($P < 0.04$) interactions were observed for ADG and d-78 BW. The reductions in ADG and d-78 BW that were associated with feeding 60% DDGS were much greater for pigs using the wet-dry feeder. Additionally, the ADG and d-78 BW of barrows and gilts

using the wet-dry feeder were similar; however, with the conventional dry feeder, the ADG and d-78 BW of barrows were greater than those of gilts. Despite the interactions, ADG, ADFI, and d-78 BW were greater and F/G was poorer for pigs using the wet-dry feeder ($P < 0.001$). Pigs fed 20% DDGS had greater ($P < 0.001$) ADG and d-78 BW but better ($P < 0.001$) F/G than those fed 60% DDGS. Barrows had greater ($P < 0.02$) ADG, ADFI, and d-78 BW but poorer F/G than gilts.

From d 78 to 99, when all pigs received a common diet containing 20% DDGS and 4.5 g/ton Paylean, a trend ($P < 0.06$) for a feeder design × gender interaction was observed for ADFI. This occurred because the difference in ADFI between barrows and gilts was greater with the wet-dry feeder. Despite the interaction, ADG and ADFI were greater ($P < 0.02$) for pigs using the wet-dry feeder compared with the dry feeder and for pigs fed 60% DDGS compared with 20% DDGS in the previous period. Barrows also had greater ($P < 0.01$) ADFI and poorer F/G than gilts.

Overall (d 0 to 99, Tables 2 and 3), there were trends ($P < 0.10$) for a feeder design × gender interaction for F/G and net income per pig. These occurred because the differences in F/G and net income per pig between pigs using the wet-dry feeder and conventional dry feeder were less for gilts than barrows. No other significant interactions were observed. Pigs using the wet-dry feeder had greater ($P < 0.001$) ADG, ADFI, final BW, feed cost per pig, HCW, and backfat depth; poorer ($P < 0.05$) F/G; and decreased fat-free lean, jowl fat IV, premium per pig, value per cwt live, and net income per pig. There was also a trend ($P < 0.09$) for pigs using the wet-dry feeder to have greater total revenue per pig because of their heavier final BW. Feeding 60% DDGS from d 0 to 78 resulted in decreased ($P < 0.02$) ADG, final BW, feed cost per pig, HCW, and backfat depth; poorer ($P < 0.05$) F/G; and decreased fat-free lean, jowl fat IV, and net income per pig. There was also a trend ($P < 0.08$) for pigs fed 60% DDGS from d 0 to 78 to have greater value per cwt live. This was primarily due to a marginal improvement in fat-free lean but also to the absence of a reduction in yield that is commonly associated with feeding increasing levels of DDGS. The absence of a reduction in yield is likely because the level of DDGS was reduced from 60% to 20% for the last 21 d. Barrows had greater ($P < 0.01$) ADG, ADFI, final BW, feed cost per pig, HCW, and backfat depth; poorer F/G; and decreased fat-free lean, jowl fat IV, premium per pig, value per cwt live, and net income per pig.

Discussion

Feeding gilts with a conventional dry feeder and a diet containing 60% DDGS to d 78 followed by 20% DDGS and 4.5 g/ton Paylean for the last 21 d resulted in the greatest net income in this experiment. The net income per pig was $25.23 greater for these gilts compared with barrows fed 20% DDGS with the wet-dry feeder. Although these gilts grew slower, they were leaner and more efficient and had a greater net income than these barrows.

In this experiment, the ADG, ADFI, and final weight of barrows and gilts were increased with a wet-dry feeder. Although ADG, ADFI, and final weight were greater for barrows than for gilts, the differences in ADG and final weight between barrows and gilts using the wet-dry feeder were less than those of barrows and gilts using the conventional dry feeder. Also, in spite of the expected overall differences in growth between

barrows and gilts, the ADG of gilts using the wet-dry feeder was nearly 5% greater than that of barrows using the conventional dry feeder, and the final weight of gilts using the wet-dry feeder was nearly 3% greater than that of barrows using the conventional dry feeder. These data suggest that swine producers could use wet-dry feeders to manage variation in growth rates within a population of pigs and potentially improve facility utilization. Although the difference in net income per pig between gilts fed with wet-dry feeders and barrows fed with conventional feeders was $3.73/pig better for gilts compared with barrows, our economic analysis indicates that the net income per pig was still lower by $8.09/pig for gilts fed with the wet-dry feeder compared with gilts fed with the conventional feeder. The greater feed cost per pig, greater backfat depth, and poorer F/G resulted in a lower net income ($9.96) for pigs fed with a wet-dry feeder.

Despite the reductions in ADG and final weight that were associated with increasing DDGS from 20% to 60% during d 0 to 78, the ADG of pigs fed 60% DDGS with the wet-dry feeder was 5% greater than that of pigs fed 20% DDGS with a conventional dry feeder, and the final weight of pigs fed 60% DDGS with the wet-dry feeder was nearly 4% greater than that of pigs fed 20% DDGS with a conventional dry feeder. Clearly, wet-dry feeders could be used to overcome the negative effect of increasing levels of DDGS on ADG. Despite their reduced ADG and poorer F/G, pigs fed 60% DDGS from d 0 to 78 had a lower feed cost per pig and greater net income ($6.16) than pigs fed 20% DDGS from d 0 to 99. Switching pigs fed 60% DDGS to 20% DDGS for the last 21 d resulted in improvements in their ADG and ADFI and likely improved their final weight and carcass yield. However, the jowl fat IV values of these pigs remained considerably higher than the levels deemed acceptable by various packers.

Unlike previous experiments comparing wet-dry and conventional feeders (Rantanen et al., 1995; Amornthewaphat et al., 2000; Bergstrom et al., 2008), F/G was considerably poorer for pigs using the wet-dry feeder in this experiment, particularly in the early period for pigs fed 60% DDGS. Also, F/G was considerably poorer for pigs fed 60% DDGS in the later periods. An explanation for this may be that there was more feed wastage associated with the type of diets used in the current experiment than for diets in other experiments. Initially, all of the conventional dry feeders were set to a common feeder gap opening of approximately 1 in., which was determined to be optimal in previous experiments (Duttlinger et al., 2008[6]). The wet-dry feeders were initially adjusted to a common feeder gap opening of approximately 1.25 in., which was used in previous experiments as suggested by a representative of the feeder manufacturer. This setting appeared to be acceptable for a short period just prior to the initiation of the experiment. However, once the experiment began, the feed pans in most of the pens receiving the 60% DDGS diet became covered (or filled) with feed very quickly, and this was observed to be much worse for the wet-dry feeders.

In our previous experiments (Bergstrom et al., 2008), the diets were formulated using 5% bakery by-product, contained various amounts of choice white grease, and contained from 9% to 30% DDGS. Few experiments have evaluated diets containing 60% DDGS. Differences in the flowability characteristics of the feeds may account for some of the differences in ADFI (or feed disappearance) and F/G observed within and

[6] Duttlinger et al., Swine Day 2008, Report of Progress 1001, pp. 204-214.

between experiments. Because of the flowability characteristics encountered in this experiment, individual feeders were adjusted daily as needed to obtain a targeted pan coverage of just greater than 50%, as suggested by Duttlinger et al. (2008) in previous experiments. This was difficult to achieve initially but became easier as pigs grew larger. Experiments to identify the optimal adjustment for wet-dry feeders have not been reported, and further experiments are needed to determine the optimum feeder adjustment for various feeders, diets (e.g., pellet vs. meal, high oil vs. low oil ingredients, angle of repose), feeder stocking densities, and BW.

In conclusion, using wet-dry feeders improved ADG and ADFI of growing-finishing pigs and may improve the performance of slower growing populations within a group (e.g., gilts). Wet-dry feeders may also restore the growth rates of pigs fed adverse levels of DDGS. However, more research is needed to resolve concerns with F/G, carcass leanness, and economic returns. Future research may improve our understanding of the dynamics of feeder design, water source and location relative to the feeder, feeder adjustment, feed intake, feed wastage, feeder space, feeding behavior, and diet composition and the related consequences for growing-finishing pigs.

Figure 1. Conventional dry feeder with cup waterer.

Figure 2. Wet-dry feeder.
Note that the cup waterer was shut off so the only source of water was through the feeder.

Table 1. Diet composition[1]

	Dietary phase						
	d 0 to 28		d 28 to 56		d 56 to 78		d 78 to 99
DDGS,%[2]:	20	60	20	60	20	60	20
Ingredient, %							
Corn	60.07	26.45	63.00	29.90	66.84	33.55	58.36
Soybean meal (46.5% CP)	18.06	11.20	15.25	7.83	11.49	4.24	19.85
DDGS	20.00	60.00	20.00	60.00	20.00	60.00	20.00
Limestone	1.00	1.40	0.95	1.35	0.90	1.35	1.00
Salt	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Liquid lysine (60%)	0.40	0.50	0.35	0.48	0.33	0.43	0.33
VTM + OptiPhos 2000[3]	0.12	0.10	0.10	0.09	0.09	0.08	0.08
Paylean	---	---	---	---	---	---	0.025
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Cost, $/lb[4]	0.110	0.098	0.107	0.096	0.104	0.093	0.117
Calculated analysis							
SID[5] amino acids, %							
Lysine, %	0.95	0.95	0.85	0.85	0.74	0.74	0.95
Isoleucine:lysine, %	68	77	70	80	72	85	71
Leucine:lysine, %	175	231	188	249	204	278	180
Methionine:lysine, %	31	40	33	43	35	48	32
Met & Cys:lysine, %	63	81	67	86	72	96	65
Threonine:lysine, %	61	73	64	76	67	82	64
Tryptophan:lysine, %	17	18	18	18	18	18	18
Valine:lysine, %	81	97	85	101	89	110	84
CP, %	18.9	23.8	17.9	22.5	16.5	21.1	19.6
Total lysine, %	1.10	1.18	0.99	1.07	0.87	0.94	1.10
ME, kcal/lb	1,526	1,521	1,527	1,522	1,529	1,523	1,526
SID lysine:ME ratio, g/Mcal	2.82	2.83	2.52	2.53	2.20	2.17	2.82
Ca, %	0.47	0.60	0.44	0.57	0.41	0.56	0.47
P, %	0.43	0.58	0.42	0.56	0.41	0.55	0.44
Available P, %	0.27	0.32	0.25	0.32	0.23	0.31	0.22

[1] Each dietary phase was fed to both feeder types during the periods described in the table.
[2] Dried distillers grains with solubles.
[3] VTM = Vitamin and trace mineral premix. OptiPhos 2000 (Enzyvia LLC, Sheridan, IN) provided 0.07% to 0.12% available P.
[4] Ingredient prices used were: corn, $195/ton; soybean meal, $325/ton; DDGS, $160/ton; limestone, $50/ton; salt, $60/ton; liquid lysine, $1,600/ton; VTM, $3,200/ton; phytase, $5,300/ton; Paylean, $57,000/ton; and $12/ton processing and delivery fee.
[5] Standardized ileal digestible.

Table 2. Effects of feeder design, gender, and dietary concentration of dried distillers grains with solubles (DDGS) on the growth performance of growing-finishing pigs[1,2]

	Feeder type													
	Wet-Dry				Conventional dry									
	20% DDGS		60% DDGS		20% DDGS		60% DDGS			Probability, P <				
Item	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	SEM	Feeder type	DDGS	Feeder × DDGS	Gender	Feeder × Gender
d 0 to 78														
ADG, lb	2.04	2.01	1.90	1.91	1.88	1.81	1.81	1.75	0.02	0.001	0.001	0.05	0.02	0.04
ADFI, lb	5.58	5.23	5.50	5.20	4.86	4.54	4.84	4.47	0.06	0.001	---[3]	---	0.001	---
F/G	2.75	2.60	2.90	2.72	2.59	2.51	2.67	2.56	0.04	0.001	0.001	---	0.001	---
d 78 BW, lb	239.5	234.8	226.6	227.5	227.3	218.8	220.2	214.9	1.8	0.001	0.001	0.05	0.01	0.04
d 78 to 99	20% DDGS													
ADG, lb	2.45	2.35	2.66	2.50	2.34	2.25	2.42	2.43	0.08	0.02	0.01	---	---	---
ADFI, lb	7.51	6.64	7.74	6.80	6.62	6.17	7.03	6.64	0.17	0.001	0.02	---	0.001	0.06
F/G	3.07	2.83	2.93	2.72	2.83	2.74	2.92	2.73	0.08	---	---	---	0.01	---
d 0 to 99														
ADG, lb	2.11	2.07	2.05	2.02	1.97	1.89	1.93	1.88	0.02	0.001	0.01	---	0.01	---
ADFI, lb	5.94	5.50	5.93	5.51	5.19	4.86	5.27	4.89	0.06	0.001	---	---	0.001	---
F/G	2.82	2.65	2.90	2.72	2.64	2.56	2.73	2.60	0.03	0.001	0.01	---	0.001	0.10
d 99 BW, lb	288.0	282.0	282.0	278.2	275.4	264.9	269.7	264.3	2.7	0.001	0.02	---	0.001	---

[1] A total of 1,080 pigs (PIC 337 × 1050) with an initial BW of 77.4 lb were placed in 40 pens containing 27 pigs each and were used in a 99-d experiment to compare the growth performance of barrows and gilts fed diets containing 20% or 60% DDGS with either a conventional dry feeder with a cup waterer or a wet-dry feeder.

[2] There were no feeder × DDGS × gender or DDGS × gender interactions observed for these criteria.

[3] Not significant ($P > 0.10$).

Table 3. Effects of feeder design, gender, and dietary concentration of dried distillers grains with solubles (DDGS) on the carcass characteristics and profitability of growing-finishing pigs[1,2]

	Feeder type												
	Wet-Dry				Conventional dry								
	20% DDGS		60% DDGS		20% DDGS		60% DDGS			Probability, P <			
Item	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	SEM	Feeder type	DDGS	Gender	Feeder × Gender
Live BW, lb	289.5	279.1	277.9	271.2	273.7	262.1	267.1	259.9	3.8	0.001	0.01	0.001	---[3]
HCW, lb	216.0	209.7	209.2	203.1	204.5	196.5	200.1	196.0	3.0	0.001	0.01	0.001	---
Yield, %	74.6	75.1	75.3	74.9	74.7	75.0	75.0	75.4	0.3	---	---	---	---
Backfat depth, in.	0.84	0.69	0.78	0.65	0.72	0.58	0.70	0.57	0.02	0.001	0.01	0.001	---
Loin depth, in.	2.33	2.38	2.32	2.32	2.36	2.45	2.33	2.37	0.05	---	---	---	---
Fat-free lean index	48.8	50.4	49.3	50.7	49.9	51.2	50.0	51.5	0.2	0.001	0.05	0.001	---
Jowl IV[4]													
d 78 (n = 72)	68.7	70.8	80.2	81.3	71.0	74.1	81.2	86.2	1.5	0.001	0.001	0.001	---
d 99 (n = 72)	70.3	73.8	79.3	81.4	72.0	75.0	81.0	82.9	1.2	0.05	0.001	0.001	---
Live bid, $/cwt	40.50												
Premium/pig, $	-2.07	4.61	2.13	4.73	4.14	7.35	4.69	7.31	1.09	0.001	---	0.001	---
Value live, $/cwt	39.91	42.25	41.38	42.34	42.13	43.40	42.36	43.39	0.40	0.001	0.08	0.001	---
Revenue/pig, $	115.52	117.95	114.95	114.86	115.27	113.77	113.14	112.82	1.98	0.09	---	---	---
Feed cost/pig, $	103.67	93.68	92.94	86.17	89.04	81.71	81.86	75.74	1.27	0.001	0.001	0.001	---
Facility cost/pig, $	10.40												
Pig cost at entry, $	50.00												
Net income/pig, $	-48.56	-36.14	-38.39	-31.71	-34.16	-28.34	-28.95	-23.33	1.69	0.001	0.001	0.001	0.09

[1] A total of 885 pigs (PIC 337 × 1050) were used to compare carcass characteristics and profitability of barrows and gilts fed 20% or 60% DDGS with either a conventional dry feeder with a cup waterer or a wet-dry feeder.

[2] There were no feeder × DDGS × gender, feeder × DDGS, or DDGS × gender interactions observed for these criteria.

[3] Not significant ($P > 0.10$).

[4] A DDGS × day interaction (P < 0.02) was observed for jowl iodine value (IV). Jowl IV was greater on d 99 for pigs that were fed 20% DDGS throughout the experiment but was greater on d 78 for pigs fed 60% DDGS from d 0 to 78.