Kansas Agricultural Experiment Station Research Reports

Volume 10
Issue 6 *Swine Day*

Article 34

2024

Effect of Increasing 6% Oil Corn Dried Distillers Grains with Solubles on Finishing Pig Growth Performance and Carcass Characteristics

Rachelle Lazaga
Kansas State University

Katelyn N. Gaffield
Kansas State University, gaffield@k-state.edu

Mikayla S. Spinler
Kansas State University, mspinler@k-state.edu

See next page for additional authors

Recommended Citation

Lazaga, Rachelle; Gaffield, Katelyn N.; Spinler, Mikayla S.; Goodband, Robert D.; Gebhardt, Jordan T.; Tokach, Mike D.; DeRouchey, Joel M.; and Woodworth, Jason C. (2024) "Effect of Increasing 6% Oil Corn Dried Distillers Grains with Solubles on Finishing Pig Growth Performance and Carcass Characteristics," *Kansas Agricultural Experiment Station Research Reports*: Vol. 10: Iss. 6. https://doi.org/10.4148/2378-5977.8649

Effect of Increasing 6% Oil Corn Dried Distillers Grains with Solubles on Finishing Pig Growth Performance and Carcass Characteristics

Funding Source

The authors would like to thank Hord Farms West, Pipestone, MN, for providing technical assistance for this study, and JBS, Worthington, MN, for help with carcass data collection.

Authors

Rachelle Lazaga, Katelyn N. Gaffield, Mikayla S. Spinler, Robert D. Goodband, Jordan T. Gebhardt, Mike D. Tokach, Joel M. DeRouchey, and Jason C. Woodworth

Effect of Increasing 6% Oil Corn Dried Distillers Grains with Solubles on Finishing Pig Growth Performance and Carcass Characteristics

Rachelle Lazaga,[1] Katelyn Gaffield, Mikayla Spinler, Robert D. Goodband, Jordan T. Gebhardt[1], Mike D. Tokach, Joel M. DeRouchey, and Jason C. Woodworth

Summary

A total of 2,108 finishing pigs (PIC 337 × 1050; initially 54.7 ± 2.05 lb) were used in an 88-d study to investigate growth performance and carcass characteristics of pigs fed diets with increasing levels of 6% oil corn DDGS. Pigs were housed in mixed-sex pens, with 27 pigs per pen and 20 pens per treatment. Experimental diets were corn-soybean meal based with increasing levels of DDGS (0, 10, 20 and 30%) across four phases. The experiment was a randomized complete block design with barn and initial weight as blocking factors. Pens of pigs were weighed every two weeks to determine ADG, ADFI, and F/G. Three weeks prior to the end of the trial, three of the heaviest pigs in each pen were marketed. The remaining pigs were then marketed at the end of the study and carcass characteristics were also collected. Increasing DDGS decreased (linear, $P < 0.005$) ADG and worsened (linear, $P < 0.001$) F/G in both grower (54 to 168 lb) and finisher (168 to 295 lb) phases while average daily feed intake decreased (linear, $P < 0.001$) in the grower stage and tended (linear, $P < 0.075$) to increase in the finisher stage. Overall, final BW and ADG decreased (linear, $P < 0.001$) with increasing DDGS. However, average daily feed intake was not affected resulting in poorer (linear, $P < 0.001$) F/G. Caloric efficiency tended to increase (linear, $P = 0.062$) with increasing DDGS suggesting that our initial estimate of NE of DDGS (1,005 kcal/lb) was over-estimated. There was a tendency (linear, $P > 0.075$) for decreased mortalities as DDGS increased, but no statistical difference in total mortality and removals was observed. Market weight, carcass yield, HCW and loin depth decreased (linear, $P < 0.05$) with increasing DDGS in the final marketing event, but backfat depth tended to decrease (quadratic, $P = 0.076$) and percentage lean tended to increase (quadratic, $P = 0.058$) as DDGS increased up to 20%; however, then reversed when DDGS inclusion further increased to 30%. Additionally, a subset of pigs (three barrows per pen from one of two research groups) was sampled at the first marketing event for determination of carcass characteristics and iodine value (IV). Market weight, carcass yield, and HCW decreased (linear, $P \leq 0.020$; Table 5) with increasing DDGS. There were no differences in backfat depth, loin depth, or percentage lean between treatments during the

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

first marketing event. Carcass IV increased (linear, $P < 0.001$) with increasing DDGS, ranging from 62.6 mg/g for pigs fed the diet without DDGS to 71.3 mg/g for pigs fed 30% DDGS. In conclusion, increasing 6% oil corn DDGS decreased ADG, market weight, carcass yield and HCW and increased IV. Thus, the reduction in diet cost with added 6% oil DDGS needs to offset the decreased growth performance to be economically justified and needs to be evaluated on a case-by-case basis.

Introduction

Distillers dried grain with solubles (DDGS) is a coproduct from ethanol production and has been successfully included in diets fed to ruminants, pigs, and poultry. Approximately 35 million metric tons of DDGS are produced yearly in the United States and the swine industry uses more than 12% of this amount.[2] Today, more corn oil is extracted from the solubles at ethanol plants than in the past. Conventional DDGS would typically contain at least 9% oil, whereas today, with new oil extraction processes, DDGS can contain between 4 to 6% oil.

While conventional (high-oil) DDGS have been thoroughly evaluated, there is limited data on DDGS with as little as 6% oil. Therefore, the objective of this study was to evaluate 6% oil DDGS on finishing pig growth performance and carcass characteristics.

Material and Methods

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at a commercial research finishing site in southwest Minnesota. The barns were naturally ventilated and double-curtain sided. Each pen was equipped with a 5-hole stainless steel dry self-feeder and a cup waterer for ad libitum access to feed and water. Daily feed additions to each pen were accomplished using a robotic feeding system (FeedPro, FeedLogic by ComDel Innovation, Wahpeton, ND) able to record feed amounts for individual pens.

Animals and diets

A total of 2,108 pigs (PIC 337 × 1050, Hendersonville, TN) initially 54.7 ± 2.05 lb were used. Pigs were housed in two barns in mixed gender pens with 27 pigs per pen and 20 pens per treatment. Pens of pigs were allotted to one of four treatments using a completely randomized block design, with barn and initial BW as blocking factors. Experimental diets were corn-soybean meal based with 0, 10, 20 or 30% DDGS across four phases. Within dietary formulation, the energy content of DDGS was based on the Graham et al. (2014)[3] prediction equation using analyzed ether extract of the DDGS. Samples of the DDGS were collected and analyzed for DM, CP, ether extract, ADF, and amino acids (Midwest laboratories, Omaha, NE and Ajinomoto Health and Nutrition laboratories, Eddyville, IA; Table 1). All treatment diets were manufactured at the Hord Farms West Feed Mill in Pipestone, MN (Tables 2 and 3).

[2] Espinosa, C. D., Lee, S. A., and H. H. Stein. 2019. Digestibility of amino acids, energy, acid hydrolyzed ether extract, and neutral detergent fiber, and concentration of digestible and metabolizable energy in low-oil distillers dried grains with solubles fed to growing pigs. Transl. Anim. Sci. 3:662-675. doi:10.1093/tas/txz025.

[3] Graham, A. B., R. D. Goodband, M. D. Tokach, S. S. Dritz, J. M. DeRouchey, S. Nitikanchana, and J.J Updike. 2014. The effects of low-, medium-, and high-oil dried distillers grains with solubles on growth performance, nutrient digestibility, and fat quality in finishing pigs. J. Anim. Sci. 92:3610–3623 doi:10.2527/jas2014-7678.

Pens of pigs were weighed and feed deliveries were recorded approximately every 14 d to determine ADG, ADFI, and F/G. The study was divided into growing (54 to 168 lb) and finishing (168 to 295 lb) phases. Three weeks prior to the final marketing, the three heaviest pigs in each pen were selected and marketed. The remaining pigs at the end of the trial were tattooed with the specific pen identification number and marketed at a commercial abattoir (JBS Swift, Worthington, MN) for collection of standard carcass measurements (carcass yield, hot carcass weight, backfat depth, loin depth, and percentage lean).

For IV analysis, three of the heaviest barrows in each pen were selected for fat sample collection and were tattooed with the pen number. These barrows were marketed from one of the two barns at the first marketing event three weeks prior to marketing the rest of the pigs. After harvest, the carcasses were held in a cooler for at least 5 hours before the fat samples were collected from the dorsal loin-butt junction. Individual samples were analyzed for IV using Bruker Tango Near Infrared Spectroscopy (NIR) located at the abattoir's laboratory.

Statistical analysis

Data were analyzed as a randomized complete block design for one-way ANOVA using the lmer function from the lme4 package in R (version 4.1.1 (2021-08-10), R Foundation for Statistical Computing, Vienna, Austria) with pen considered the experimental unit, treatment as fixed effect, and block as a random effect. Contrast coefficients were used to compare the effect of increasing levels of 6% oil DDGS. Hot carcass weight (HCW) was used as a covariate for analysis of backfat depth, loin depth, and lean percentage. All results were considered significant at $P \le 0.05$ and marginally significant between $P > 0.05$ and $P \le 0.10$.

Results and Discussion

Increasing DDGS decreased (linear, $P < 0.005$) ADG and worsened (linear, $P < 0.001$) F/G in both grower and finisher phases, while ADFI decreased (linear, $P < 0.001$) in the grower stage but tended (linear, $P < 0.075$) to increase in the finisher phase (Table 4). Overall, final BW and ADG decreased (linear, $P < 0.001$). However, ADFI was not affected, resulting in poorer F/G (linear, $P < 0.001$) as DDGS increased in the diet. Caloric efficiency tended to increase (linear, $P = 0.062$) with increasing DDGS suggesting that our initial estimate of NE of DDGS at 1,005 kcal/lb was overestimated. The NE of DDGS would need to be 942 kcal/lb for caloric efficiency to be equal across treatments. A tendency (linear, $P < 0.075$) was observed for decreased mortalities as DDGS increased, but there was no difference in total mortality and removals.

For the final marketing event, market weight, carcass yield, HCW and loin depth decreased (linear, $P \le 0.016$), with increasing DDGS. Backfat depth tended to decrease (quadratic, $P = 0.076$) and percentage lean tended to increase (quadratic, $P = 0.058$) as DDGS increased up to 20%; however, then reversed when DDGS further increased to 30%.

For the subset of pigs sampled from one of two groups at the first marketing event, market weight, carcass yield, and HCW decreased (linear, $P \le 0.020$; Table 5) with increasing DDGS. There were no differences in backfat depth, loin depth, or percentage lean between treatments during the first marketing event. Carcass IV increased (linear,

P < 0.001) with increasing DDGS, ranging from 62.6 mg/g for pigs fed 0% DDGS to 71.3 mg/g for pigs fed 30% DDGS.

In conclusion, finishing pigs fed increasing levels of 6% oil DDGS had decreased ADG and poorer F/G. Market weight, HCW, and carcass yield all decreased in parallel with the decrease in ADG. However, increasing 6% oil DDGS resulted in a decrease in mortalities in this study. Therefore, the economic impact of the decrease in ADG and F/G with the addition of 6% oil DDGS needs to be evaluated on a case-by-case basis.

Acknowledgments

The authors would like to thank Hord Farms West, Pipestone, MN, for providing technical assistance for this study, and JBS, Worthington, MN, for help with carcass data collection.

Table 1. Chemical analysis of corn DDGS (as-fed basis)[1,2]

Nutrient, %	DDGS
Dry matter	88.10
Crude protein	29.15
Crude fat	6.22
Acid detergent fiber	11.75
Ash	4.73
Total AA	
Arg	1.35
Cys	0.54
His	0.79
Ile	1.04
Leu	3.40
Lys	0.89
Met+Cys	1.07
Thr	1.09
Trp	0.25
Val	1.37

[1] Values represent the mean of two samples analyzed in duplicate (Midwest Laboratories, Omaha, NE and Ajinomoto Health and Nutrition laboratories, Eddyville, IA).
[2] Analysis for mycotoxins was also performed (NDSU Veterinary Diagnostic Laboratory, North Dakota) with all major mycotoxin levels being below detectable levels except for low level of DON (0.369 ppm).

Table 2. Composition of phase 1 and 2 diets (as-fed basis)[1]

	Phase 1				Phase 2			
	DDGS, %				DDGS, %			
Item	**0**	**10**	**20**	**30**	**0**	**10**	**20**	**30**
Ingredient, %								
Corn	70.62	63.84	56.87	49.74	77.99	70.89	63.90	56.71
Soybean meal (47.7% CP)	26.29	23.17	20.20	17.40	19.15	16.35	13.40	10.60
DDGS, 6% oil	---	10.00	20.00	30.00	0.00	10.00	20.00	30.00
Monocalcium P (21% P)	0.65	0.40	0.20	---	0.55	0.35	0.15	---
Calcium carbonate	1.10	1.25	1.38	1.50	1.05	1.18	1.30	1.40
Sodium chloride	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Liquid lysine (55%)	0.50	0.57	0.62	0.67	0.47	0.52	0.58	0.63
DL-Met	0.09	0.07	0.04	---	0.07	0.04	---	---
L-Trp	0.02	0.03	0.03	0.04	0.02	0.03	0.03	0.04
L-Val	0.04	0.01	---	---	0.03	---	---	---
Thr[2]	0.14	0.13	0.12	0.10	0.12	0.10	0.09	0.07
Phytase[3]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Vitamin-trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100	100	100
Calculated analysis								
SID amino acids, %								
Lys	1.10	1.10	1.10	1.10	0.91	0.91	0.91	0.91
Ile:Lys	60	60	60	60	60	60	60	60
Leu:Lys	130	138	147	157	139	150	161	172
Met:Lys	32	31	30	29	33	31	30	32
Met & Cys:Lys	56	56	56	56	58	58	58	61
Thr:Lys	62	62	62	62	62	62	63	62
Trp:Lys	19	19	19	19	19	19	19	19
Val:Lys	70	70	72	76	70	72	75	79
His:Lys	40	41	42	44	41	43	44	46
Total Lys, %	1.23	1.26	1.28	1.30	1.02	1.05	1.07	1.10
NE NRC, kcal/lb	1,115	1,104	1,092	1,079	1,136	1,123	1,111	1,098
SID Lys:NE, g/Mcal	4.47	4.52	4.57	4.62	3.63	3.68	3.72	3.76
CP, %	18.92	19.69	20.53	21.43	16.07	16.95	17.80	18.71
Ca, %	0.62	0.62	0.62	0.63	0.56	0.57	0.57	0.57
STTD P, %	0.39	0.39	0.39	0.40	0.36	0.36	0.36	0.38
Ca:P	1.22	1.23	1.22	1.20	1.23	1.22	1.20	1.16

[1] Phases 1 and 2 were fed from 54 to107 and 107 to 168 lb, respectively.
[2]ThrPro; CJ America-Bio, Downers Grove, IL.
[3]Optiphos (Huvepharma, Sofia, Bulgaria) was included at 567 FTU/lb, providing an estimated release of 0.12% STTD P for phase 1 and phase 2.

Table 3. Diet composition of phase 3 and 4 diets (as-fed basis)[1]

	Phase 3				Phase 4			
	DDGS, %				DDGS, %			
Item	**0**	**10**	**20**	**30**	**0**	**10**	**20**	**30**
Ingredient								
Corn	82.73	75.55	68.63	61.51	85.46	78.49	71.34	64.08
Soybean meal (47.7% CP)	14.60	11.85	8.90	5.95	12.05	9.13	6.33	3.53
DDGS, 6% oil	---	10.00	20.00	30.00	---	10.00	20.00	30.00
Monocalcium P (21% P)	0.55	0.35	---	---	0.45	0.23	---	---
Limestone, ground	1.00	1.13	1.30	1.33	0.98	1.08	1.20	1.23
Sodium chloride	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
DL-Met	0.04	0.01	---	---	0.03	---	---	---
L-Trp	0.02	0.03	0.03	0.04	0.03	0.03	0.04	0.04
L-Val	0.01	---	---	---	---	---	---	---
Liquid lysine 55%	0.44	0.49	0.54	0.60	0.42	0.48	0.53	0.58
Thr[2]	0.10	0.08	0.07	0.06	0.12	0.10	0.09	0.07
Phytase[3]	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
Vitamin-trace mineral premix	0.10	0.10	0.10	0.10	0.05	0.05	0.05	0.05
Total	100	100	100	100	100	100	100	100
Calculated analysis								
SID amino acids, %								
Lys	0.78	0.78	0.78	0.78	0.71	0.71	0.71	0.71
Ile:Lys	60	60	60	60	60	60	60	60
Leu:Lys	148	162	174	187	155	169	183	197
Met:Lys	31	30	32	35	32	31	34	37
Met & Cys:Lys	59	59	63	67	60	61	66	70
Thr:Lys	63	63	63	63	66	66	66	66
Trp:Lys	19	19	19	19	19	19	19	19
Val:Lys	70	74	79	83	70	75	81	86
His:Lys	43	45	46	48	44	45	47	49
Total Lys, %	0.88	0.91	0.93	0.95	0.81	0.83	0.85	0.88
NE NRC, kcal/lb	1,149	1,136	1,125	1,112	1,157	1,146	1,134	1,120
SID Lys:NE, g/Mcal	3.08	3.11	3.14	3.18	2.78	2.81	2.84	2.87
CP, %	14.21	15.13	16.00	16.85	13.22	14.08	15.00	15.91
Ca, %	0.53	0.53	0.53	0.53	0.49	0.48	0.48	0.48
STTD P, %	0.33	0.33	0.31	0.35	0.29	0.29	0.29	0.33
Ca:P	1.21	1.20	1.25	1.13	1.21	1.18	1.17	1.05

[1] Phases 3 and 4 were fed from 168 to 231 and 231 to 295 lb, respectively.
[2]ThrPro; CJ America-Bio, Downers Grove, IL.
[3]Optiphos (Huvepharma, Sofia, Bulgaria) was included at 284 FTU/lb and 226 FTU/lb providing an estimated release of 0.10% and 0.09% STTD P for phase 3 and phase 4, respectively.

Table 4. Effects of increasing 6% oil DDGS on growth performance of finishing pigs[1]

	DDGS, %					*P* =	
Item	0	10	20	30	SEM	Linear	Quadratic
BW, lb							
Initial	54.7	54.6	54.7	54.5	2.05	0.503	0.817
Midpoint	171.9	169.8	166.9	164.0	3.37	< 0.001	0.663
Final	301.7	295.4	293.8	290.2	3.65	< 0.001	0.325
Wt gain, lb/pig placed[2]	235.1	232.5	225.1	223.0	4.33	< 0.001	0.927
Grower							
ADG, lb	2.04	2.00	1.95	1.89	0.030	< 0.001	0.568
ADFI, lb	4.56	4.52	4.46	4.40	0.087	0.001	0.645
F/G	2.23	2.26	2.29	2.32	0.016	< 0.001	0.823
Finisher							
ADG, lb	2.26	2.20	2.20	2.19	0.022	0.005	0.256
ADFI, lb	6.88	6.79	6.92	6.97	0.058	0.075	0.257
F/G	3.05	3.09	3.15	3.19	0.024	< 0.001	0.815
Overall							
ADG, lb	2.15	2.11	2.08	2.04	0.013	< 0.001	0.707
ADFI, lb	5.69	5.64	5.67	5.66	0.050	0.780	0.625
F/G	2.64	2.68	2.73	2.78	0.014	< 0.001	0.657
Caloric efficiency, kcal/lb	3,021	3,028	3,056	3,070	15.8	0.062	0.795
Carcass characteristics, final marketing event							
Market weight, lb	302.7	296.5	295.2	291.4	3.63	< 0.001	0.356
Yield, %	74.5	74.1	73.7	73.5	0.21	< 0.001	0.580
HCW, lb	225.5	219.8	217.6	214.3	2.91	< 0.001	0.273
Backfat depth, in[3]	0.66	0.64	0.63	0.65	0.014	0.592	0.076
Loin depth, in[3]	2.76	2.74	2.75	2.69	0.020	0.016	0.346
Lean, %[3]	57.1	57.3	57.4	57.0	0.25	0.762	0.058
Removals, %	4.0	4.5	5.1	5.6	1.16	0.235	0.950
Mortality, %	4.8	4.1	3.0	2.8	1.11	0.075	0.872
Total mortality and removals, %	9.0	8.7	8.2	8.6	1.51	0.786	0.838

[1]A total of 2,108 (PIC 337 × 1050; initially 54.7 ± 2.05 lb) pigs were used with 20 replications per treatment. [2]Total wt gain ÷ total pig placed per pen.
[3]Adjusted using HCW as a covariate.

Table 5. Effect of increasing 6% oil DDGS on carcass characteristics and iodine value (IV) of pigs at first marketing event[1]

	DDGS, %					*P* =	
Item	**0**	**10**	**20**	**30**	**SEM**	**Linear**	**Quadratic**
Carcass characteristics							
Pigs, n	29	23	28	24	---	---	---
Market weight, lb	300.7	296.9	294.5	289.1	2.80	< 0.001	0.685
Carcass yield, %	73.2	72.8	72.3	71.8	0.46	0.020	0.909
HCW, lb	219.1	213.8	211.6	203.3	3.04	< 0.001	0.542
Backfat depth, in[2]	0.70	0.69	0.69	0.74	0.029	0.368	0.221
Loin depth, in[2]	2.54	2.65	2.59	2.67	0.070	0.300	0.730
Lean, %[2]	55.7	56.2	56.1	55.5	0.535	0.761	0.245
IV, mg/g	62.6	65.1	68.0	71.3	0.812	< 0.001	0.607

[1] On d 93 of the experiment, 123 pigs (three heaviest barrows per pen) were selected and sent to the packing plant for carcass data and fat sample collection. Data from 104 carcasses were collected at the plant and used for this analysis. Fat samples were collected from the dorsal loin-butt junction and were immediately chilled and later analyzed for iodine value using Near Infrared Spectroscopy (NIR).
[2] Adjusted using HCW as covariate.