Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 10 *Swine Day (1968-2014)*

Article 1140

2007

Effects of dried distillers grains with solubles and extruded expelled soybean meal on growth performance and carcass characteristics of grow-finish pigs

J M. Benz

Michael D. Tokach

Jim L. Nelssen

See next page for additional authors

Effects of dried distillers grains with solubles and extruded expelled soybean meal on growth performance and carcass characteristics of grow-finish pigs

Authors

J M. Benz, Michael D. Tokach, Jim L. Nelssen, Joel M. DeRouchey, Robert D. Goodband, and Steven S. Dritz

EFFECTS OF DRIED DISTILLERS GRAINS WITH SOLUBLES AND EXTRUDED EXPELLED SOYBEAN MEAL ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF GROW-FINISH PIGS[1]

J. M. Benz, M. D. Tokach, S. S. Dritz[2], J. L. Nelssen, J. M. DeRouchey, and R. D. Goodband

Summary

A total of 120 barrows (maternal line PIC 1050) with an initial BW of 105.7 lb were used in an 83-d trial to study the effects of dried distillers grains with solubles (DDGS) and extruded expelled soybean meal (EESM) on growth performance and fat quality. Pigs were blocked by weight and randomly allotted to one of six treatments with two pigs per pen and 10 pens per treatment. Diets were: a corn-soybean meal control diet with no added fat, corn-EESM diet with no added fat, corn-EESM diet with 15% DDGS, corn-soybean meal diet with 15% DDGS, and 1.55% choice white grease (CWG), corn-soybean meal diet with 3.25% CWG, and corn-soybean meal diet with 4.7% CWG. Diets were formulated to have three dietary iodine value (IV) levels (42, 55, and 62) to compare the impact of fat source within dietary IV levels. On d 83, jowl and backfat samples were collected. Pigs fed the control diet, EESM, or 4.7% CWG had increased ADG compared with pigs fed the diet containing EESM with 15% DDGS. Pigs fed the control diet had increased ADFI compared with all other treatment. Pigs fed EESM with 15% DDGS and the diets with 4.7% CWG had improved F/G compared with pigs fed the control and pigs fed DDGS with CWG. Pigs fed high CWG had greater (P<0.05) loin depth compared with pigs fed low CWG. Pigs fed either of the diets with 15% DDGS had increased backfat IV compared with pigs fed diets without DDGS. Pigs fed EESM had increased backfat IV when compared with the control diet or diets with 3.25 or 4.7% CWG. Adding DDGS to the diet or using EESM increased IV of jowl fat. Adding CWG to the control diet also increased IV of jowl fat. Feeding ingredients with higher levels of unsaturated fat, such as EESM and DDGS, had a greater impact on fat IV than CWG even when diets were formulated to similar IV levels.

(Key words, added fat, pork quality, iodine value.)

Introduction

Dried distillers grains with solubles (DDGS) and extruded expelled soybean meal (EESM) can be economical to feed to growing and finishing hogs. However, the inclusion of these ingredients increases the dietary fat level when they are substituted for corn or soybean meal. Carcass composition is altered when fat level increases in the diet, causing softer carcass fat. This may have implications from a

[1]The authors thank the Kansas Corn Growers and Soybean Associations and the Kansas Pork Association for partial financial support.

[2]Food Animal Health and Management Center, College of Veterinary Medicine.

processor acceptance standpoint. Iodine value is a measure of the level of unsaturation of fats, and therefore a measure of fat firmness. Carcass iodine value must be further researched to know the full carcass quality implications from feeding different fat sources for various time periods. Therefore, the purpose of this trial was to evaluate the effects of dried distillers grains (DDGS) and extruded expelled soybean meal (EESM) growth performance and carcass characteristics of grow-finish pigs.

Procedures

One hundred twenty crossbred barrows, (PIC 1050) with an initial weight of 105.7 lb were used in an 83-d experiment. Pigs were blocked by weight and allotted to one of six treatments with 10 replicate pens per treatment. Pigs were housed with two pigs per pen in an environmentally controlled finishing barn with 4 ft × 4 ft pens with totally slatted floors. Each pen was equipped with a one-hole dry self-feeder and nipple waterer to allow *ad libitum* access to feed and water.

Diets were: a corn-soybean meal control diet with no added fat (calculated IV of 42), corn-EESM diet with no added fat (calculated IV of 54), corn-EESM diet with 15% DDGS (calculated IV of 62), corn-soybean meal diet with 15% DDGS, and choice white grease (CWG, calculated IV of 54); corn-soybean meal diet with low CWG (calculated IV of 54), and corn-soybean meal diet with high CWG (calculated IV of 62). Diets were formulated to have three dietary IV levels to compare the impact of fat source within dietary IV levels. The analyzed dietary IV was lower than the calculated values. However, two treatments had very similar weighted IV (DDGS with CWG and high CWG (Table 6). Prior to being placed on test, pigs were fed a corn-soybean meal-based diet.

Diets were formulated to be fed in three phases from d 0 to 26, 26 to 55, and 55 to 83 to correspond with approximate weight ranges of 90 to 150, 150 to 210, and 210 to 270 lb (Tables 1, 2, and 3). A constant TID lysine: ME ratio was maintained by altering the corn and soybean meal level in the basal diet when adding the fat sources.

Pigs and feeders were weighed on d 12, 26, 41, 55, 69, and 83 to calculate ADG, ADFI, and F/G. Pen served as experimental unit for all statistical analysis.

Pigs were slaughtered at Triumph Foods of St. Joseph, MO at the end of the 83 d trial for collection of individual carcass data. The pigs were marked with an individual tattoo prior to marketing. At 24 hours postmortem, jowl samples were collected and frozen until further processing and analysis. Iodine value was calculated from the following equation (AOCS, 1998):

C16:1(0.95)+C18:1(0.86)+C18:2(1.732)+C18:3(2.616)+C20:1(0.785)+C22:1(0.723).

The fatty acids are represented as a percentage of the total fatty acids in the sample.

Data were analyzed in a randomized complete-block design with pen as the experimental unit. Analysis of variance was performed by using the MIXED procedure of SAS. Contrasts were used to determine the effects of the dietary treatments. Hot carcass weight was used as a covariate for last rib backfat, 10^{th} rib backfat, loin depth, and percentage lean.

Results and Discussion

From d 0 to 83, pigs fed the control diet, EESM or high CWG had greater (P<0.05) ADG compared with pigs fed EESM with 15% DDGS (Table 4). Pigs fed the control diet had greater (P<0.05) ADFI compared with pigs fed all other treatments. Pigs fed EESM with 15% DDGS and high CWG had improved (P<0.05) F/G compared with pigs

fed the control diet or those fed DDGS and CWG.

Pigs fed high CWG had greater ($P<0.05$) loin depth compared with pigs fed low CWG. Pigs fed EESM tended to have greater ($P<0.08$) loin depth than pigs fed low CWG (Table 5). Percentage lean was unaffected by dietary treatment. Pigs fed the control, 15% DDGS with CWG, low CWG, and high CWG tended to have greater ($P<0.08$) dressing percentages compared with pigs fed EESM.

Pigs fed EESM with 15% DDGS had increased ($P<0.05$) iodine value for jowl fat compared with all other treatments. Pigs fed 15% DDGS with CWG had increased ($P<0.05$) iodine value for jowl fat compared with pigs fed the control, EESM, low CWG, and high CWG. Pigs fed EESM had increased ($P<0.05$) iodine value for jowl fat compared with pigs fed the control and low CWG. Pigs fed low CWG and high CWG had increased iodine value for jowl fat compared with pigs fed the control. Pigs fed EESM with 15% DDGS and 15% DDGS with CWG had increased ($P<0.05$) iodine value and percentage 18:2 fatty acids for backfat compared with all other treatments. Pigs fed EESM and EESM with 15% DDGS had increased ($P<0.05$) iodine value and percentage 18:2 fatty acids for backfat compared with pigs fed the control, low CWG, and high CWG. Pigs fed EESM with 15% DDGS had increased ($P<0.05$) percentage 18:2 fatty acids for jowl fat compared with pigs fed the control, EESM, low CWG, and high CWG. Pigs fed EESM and 15% DDGS with CWG had increased ($P<0.05$) percentage 18:2 fatty acids for jowl fat compared with pigs fed the control, low CWG, and high CWG. Pigs fed the control had increased ($P<0.05$) percentage saturated fatty acids for jowl fat and backfat compared with all other treatments. Pigs fed EESM, low CWG, and high CWG had increased ($P<0.05$) percentage saturated fatty acids for jowl fat compared with pigs fed the EESM with 15% DDGS. Pigs fed the EESM, low CWG, and high CWG had increased ($P < 0.05$) percentage saturated fatty acids for backfat compared with pigs fed EESM with 15% DDGS and 15% DDGS with CWG.

Most treatments had jowl fat iodine values approximately 5 g/100g h greater than backfat iodine values. However, both diets containing DDGS had jowl fat and backfat iodine values that were more similar. This can be explained by evaluating the effect each individual fatty acid had on iodine value (Table 6). Pigs fed the control diet had an increase of 4 g/100g from backfat to jowl fat due to C 18:1 fatty acids (effect of backfat C 18:1 = 36.05, effect of jowl fat C 18:1 = 40.05). This trend is similar for all treatments and explains why jowl fat iodine value is higher than backfat iodine value. The effect C 18:2 fatty acids had on iodine value is similar for jowl fat and backfat in most treatments. However, pigs fed either diet containing DDGS had less C 18:2 fatty acids in jowl fat than backfat. This difference was similar to the effect C 18:1fatty acids had, and essentially cancelled it out.

These results confirm that adding fat to finishing pig diets improves growth performance. Feeding DDGS in this trial resulted in a decrease in ADG and ADFI. Adding DDGS, EESM, or CWG increased IV and C 18:2, and reduced C saturated fatty acids. Finally, feeding ingredients with higher levels of unsaturated fat, such as EESM and DDGS, had a greater impact on fat iodine value than CWG even when dietary iodine values were similar. Also, feeding pigs a diet with more unsaturated fat may lead to jowl fat and backfat to have more similar iodine values.

Table 1. Phase 1 Diet Composition (as-fed basis)[a]

Ingredient, %	Control	EESM	EESM + DDGS	DDGS + CWG	Low CWG	High CWG
Corn	72.06	70.31	57.27	56.41	66.84	64.54
Soybean meal (46.5% CP)	25.09	---	---	24.44	27.06	27.86
Dried distillers grains with solubles	---	---	15.00	15.00	---	---
Extruded expelled soybean meal	---	26.85	25.15	---	---	---
Choice white grease	---	---	---	1.55	3.25	4.70
Monocalcium P (21% P)	1.10	1.15	0.75	0.75	1.15	1.20
Limestone	0.95	0.90	1.05	1.05	0.90	0.90
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.15	0.15	0.15	0.15	0.15	0.15
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15
L-lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
Total lysine, %	1.06	1.11	1.12	1.10	1.11	1.13
True ileal digestible amino acids						
Lysine, %	0.95	0.98	0.98	0.97	0.99	1.01
Methionine:lysine ratio, %	28	28	31	31	27	27
Met & cys:lysine ratio, %	57	56	64	64	56	55
Threonine:lysine ratio, %	61	60	66	66	60	60
Tryptophan:lysine ratio, %	19	19	21	21	19	19
ME, kcal/lb	1,505	1,562	1,562	1,541	1,572	1,601
Crude fat, %	3.2	4.5	5.1	5.4	6.3	7.6
Ca, %	0.67	0.67	0.67	0.67	0.67	0.68
P, %	0.61	0.62	0.61	0.60	0.62	0.62
Available P, %	0.30	0.31	0.31	0.31	0.31	0.32
TID Lys:Cal ratio	2.58	2.58	2.58	2.58	2.58	2.58
Calculated IV	40	57	65	57	57	65
Analyzed IV	33.27	50.01	53.83	57.36	46.34	54.70

[a] Diets fed in meal form from d 0 to 26.
[b]DDGS nutrient values for diet formulation were derived from NRC, 1998.

Table 2. Phase 2 Diet Composition (as-fed basis)[a]

Ingredient, %	Control	EESM	EESM + DDGS	DDGS + CWG	Low CWG	High CWG
Corn	80.07	79.08	66.05	66.18	76.82	74.60
Soybean meal (46.5% CP)	17.28	---	---	15.87	18.33	19.05
Dried distillers grains with solubles	---	---	15.00	15.00	---	---
Extruded expelled soybean meal	---	18.20	16.50	---	---	---
Choice white grease	---	---	---	0.50	2.15	3.65
Monocalcium P (21% P)	1.00	1.05	0.65	0.65	1.05	1.05
Limestone	0.90	0.90	1.05	1.05	0.90	0.90
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.13	0.13	0.13	0.13	0.13	0.13
Trace mineral premix	0.13	0.13	0.13	0.13	0.13	0.13
L-lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
Total lysine, %	0.85	0.87	0.88	0.86	0.87	0.89
True ileal digestible amino acids						
Lysine, %	0.75	0.77	0.77	0.76	0.77	0.79
Methionine:lysine ratio, %	30	30	35	35	30	29
Met & cys:lysine ratio, %	63	62	71	72	61	60
Threonine:lysine ratio, %	62	62	69	70	62	62
Tryptophan:lysine ratio, %	19	19	21	21	19	19
ME, kcal/lb	1,510	1,547	1,548	1,524	1,553	1,584
Crude fat, %	3.4	4.3	4.9	4.6	5.4	6.8
Ca, %	0.61	0.62	0.63	0.62	0.62	0.62
P, %	0.55	0.57	0.55	0.55	0.56	0.56
Available P, %	0.27	0.28	0.28	0.28	0.28	0.28
TID Lys:Cal ratio	2.14	2.14	2.14	2.14	2.14	2.14
Calculated IV	42	54	62	54	54	62
Analyzed IV	37.68	46.67	58.90	49.79	43.96	54.48

[a]Diets fed in meal form from d 26 to 55.
[b]DDGS nutrient values for diet formulation were derived from NRC, 1998.

Table 3. Phase 3 Diet Composition (as-fed basis)[a]

Ingredient, %	Control	EESM	EESM + DDGS	DDGS + CWG	Low CWG	High CWG
Corn	84.18	83.54	70.50	71.13	81.79	79.66
Soybean meal (46.5% CP)	13.37	---	---	11.67	14.06	14.74
Dried distillers grains with solubles	---	---	15.00	15.00	---	---
Extruded expelled soybean meal	---	14.00	12.30	---	---	---
Choice white grease	---	---	---	---	1.70	3.15
Monocalcium P (21% P)	0.80	0.80	0.45	0.45	0.85	0.85
Limestone	0.90	0.90	1.00	1.00	0.85	0.85
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.13	0.13	0.13	0.13	0.13	0.13
Trace mineral premix	0.13	0.13	0.13	0.13	0.13	0.13
L-lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
Total lysine, %	0.74	0.76	0.77	0.75	0.76	0.77
True ileal digestible amino acids						
Lysine, %	0.65	0.66	0.66	0.65	0.67	0.68
Methionine:lysine ratio, %	32	32	38	38	32	31
Met & cys:lysine ratio, %	67	66	77	78	65	64
Threonine:lysine ratio, %	64	63	72	72	63	63
Tryptophan:lysine ratio, %	19	18	21	21	19	19
ME, kcal/lb	1,514	1,543	1,544	1,518	1,549	1,578
Crude fat, %	3.5	4.2	4.8	4.2	5.1	6.5
Ca, %	0.56	0.56	0.56	0.55	0.55	0.55
P, %	0.50	0.50	0.49	0.49	0.50	0.50
Available P, %	0.22	0.22	0.23	0.23	0.23	0.23
TID Lys:Cal ratio	1.85	1.85	1.85	1.85	1.85	1.85
Calculated IV	44	53	61	53	53	61
Analyzed IV	37.11	45.88	55.25	46.52	41.29	46.96

[a]Diets fed in meal form from d 55 to 82.
[b]DDGS nutrient values for diet formulation were derived from NRC, 1998.

Table 4. Effects of DDGS and EESM on Growth Performance[a]

Item	Control	EESM	EESM + DDGS	DDGS + CWG	Low CWG	High CWG	SE
D 0 to 82							
ADG, lb	2.08[b]	2.07[b]	1.83[c]	2.00[bc]	2.04[bc]	2.18[b]	0.08
ADFI, lb	6.37[b]	5.98[c]	5.54[d]	5.92[c]	5.75[cd]	5.86[cd]	0.16
F/G	3.17[c]	2.95[bc]	2.65[b]	3.00[c]	2.88[bc]	2.74[b]	0.13

[a]Total of 120 pigs (initial weight 105.7 lbs) with 10 observations per treatment.
[bcd]Treatments with different superscripts differ $P<0.05$.

Table 5. Effects of DDGS and EESM on Carcass Performance[a]

Item	Control	EESM	EESM + DDGS	DDGS + CWG	Low CWG	High CWG	SE
Loin depth, in	2.04[bc]	2.00[bc]	2.13[bc]	2.08[bc]	1.93[b]	2.19[c]	0.09
Lean, %	50.8	50.9	51.2	51.1	50.6	51.3	0.49
Dress, %	73.0	71.7	72.0	73.0	73.1	73.0	0.54
Last rib fat, in	0.94	0.90	0.88	0.94	0.92	0.97	0.04
10th rib fat, in	0.82	0.78	0.82	0.79	0.78	0.83	0.04
BF IV	59.92[b]	64.99[c]	70.78[d]	69.34[d]	62.11[b]	61.82[b]	0.94
Jowl IV	64.60[b]	68.80[d]	72.30[f]	70.16[e]	66.25[c]	67.09[cd]	0.61
BF 18:2, %	11.20[b]	14.48[c]	18.44[d]	17.32[d]	11.80[b]	11.36[b]	0.58
Jowl 18:2, %	11.02[b]	13.82[c]	16.17[d]	14.90[cd]	11.61[b]	11.86[b]	0.43
BF Sat., %	42.83[b]	41.06[c]	38.43[b]	38.48[b]	41.03[c]	40.78[c]	0.52
Jowl Sat., %	37.43[e]	36.07[c]	34.41[b]	35.18[bc]	36.26[d]	35.48[cd]	0.38

[a]Total of 110 pigs.
[bcdef]Treatments with different superscripts differ, $P<0.05$.

Table 6. Effects of Individual Fatty Acids on Iodine Value

Item	Control	EESM	EESM + DDGS	DDGS + CWG	Low CWG	High CWG
Calculated diet IV	42.1	54.28	62.22	54.35	54.32	62.19
Analyzed diet IV	36.27	47.32	56.1	50.67	43.59	51.59
Analyzed carcass IV						
Backfat	59.92	64.99	70.78	69.34	62.11	61.82
Jowl	64.60	68.80	72.30	70.16	66.25	67.09
Effect of individual fatty acid on IV						
Backfat						
C 16:1	2.23	2.07	1.85	1.98	2.41	2.14
C 18:1	36.05	34.48	33.30	34.30	36.80	37.61
C 18:2	19.40	25.08	31.93	30.01	20.44	19.68
C 18:3	1.51	2.56	2.74	2.09	1.70	1.58
C 20:1	0.72	0.80	0.95	0.95	0.76	0.81
C 22:1	0.01	0.01	0.01	0.01	0.01	0.01
Jowl						
C 16:1	2.91	2.82	2.61	2.76	3.03	2.86
C 18:1	40.05	38.51	37.94	38.46	40.32	40.84
C 18:2	19.09	23.93	28.01	25.80	20.11	20.54
C 18:3	1.75	2.63	2.73	2.17	1.93	1.92
C 20:1	0.79	0.90	1.00	0.96	0.85	0.91
C 22:1	0.01	0.01	0.01	0.01	0.01	0.01