EFFECTS OF CHOICE WHITE GREASE OR SOYBEAN OIL 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 144 barrows and gilts (PIC) with an initial BW of 97 lb were used to evaluate the effects of dietary fat source and duration of feeding on growth performance and carcass fat quality. Dietary treatments included a corn-soybean meal control diet with no added fat or a 2 × 4 factorial arrangement with 5% choice white grease (CWG) or soybean oil and withdrawal of the fat 0, 14, 28, or 56 days before market (82 days). At the end of each feeding duration, pigs were switched to the control diet. At the end of the study (d 82), jowl fat and backfat samples were collected. Lengthening the duration of feeding soybean oil increased (quadratic, $P<0.01$) ADG and improved F/G. Increasing the feeding duration of CWG had no effect on ADG, but improved (quadratic, $P<0.01$) F/G. Increasing the feeding duration of CWG or soybean oil increased (quadratic, $P<0.02$) dressing percentage with the improvement being greater ($P<0.06$) for pigs fed CWG compared to pigs fed soybean oil. Gilts had increased ($P<0.01$) iodine value (IV; more unsaturated fat) compared to barrows. Increasing feeding duration of either soybean oil or CWG increased (quadratic, $P<0.01$) IV compared to pigs fed the control diet. In summary, adding fat to the diet improved pig growth performance but increased jowl fat and backfat IV. Feeding fat during any stage influenced jowl IV at market with duration of feeding having the greatest response with soybean oil.

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

Introduction

Considerable research has shown improvements in feed efficiency and average daily gain from feeding added fat to finishing pigs. Carcass composition, however, can be altered when fat is included in diets, which may have implications from a processor acceptance standpoint. Iodine value is a measure of the level of unsaturation or softness of a fat. Feeding different fat sources for various time periods may influence carcass iodine value, which is an indicator of carcass firmness and quality. Currently, Triumph Foods, St. Joseph, MO has set a maximum jowl iodine value of 73. With this in mind, the objective of this trial was to evaluate the influence removing soybean oil or choice white grease from the diet at different times before market would have on growth performance, carcass characteristics, and carcass fat iodine values.

Procedures

One hundred forty-four crossbred barrows and gilts, (PIC 337 × C22) with an initial

[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.

weight of 96.7 lb, were used in an 82 d experiment. Pigs were blocked by gender and weight and allotted to one of nine treatments with eight replicate pens per treatment. Pigs were housed two per pen in an environmentally controlled finishing barn with 4 ft × 4 ft totally slatted pens. Each pen was equipped with a one-hole dry self-feeder and nipple waterer to provide *ad libitum* access to feed and water.

Treatments were based on two different fat sources and fat withdrawal time before slaughter. The treatments included a control diet plus eight diets arranged in a 2 × 4 factorial based on fat source (choice white grease or soybean oil) and withdrawal time before market (0, 14, 28, or 56 days; Figure 1). The control diet was corn-soybean meal-based without added fat. Choice white grease (CWG) and soybean oil were added at 5% to the control diet. Prior to being placed on test, pigs had been fed a similar corn-soybean meal-based diet without added fat.

Diets were formulated to be fed in three phases from d 0 to 26, 26 to 54, and 54 to 82 to correspond with approximate weight ranges of 90 to 150, 150 to 210, and 210 to 270 lb (Tables 1 to 3). Either 5% choice white grease or soybean oil was added to each basal diet to form the experimental diets. A constant TID lysine:ME ratio was maintained by increasing the soybean meal level in the basal diet when adding the fat sources.

Pigs and feeders were weighed on d 12, 26, 40, 54, 68, and 82 to calculate ADG, ADFI, and F/G. Pigs were slaughtered at Triumph Foods of St. Joseph, MO at the end of the 82-d trial for collection of individual carcass data. The pigs were marked with an individual tattoo before marketing. At 24 h postmortem, jowl and backfat samples were collected and frozen until further processing and analysis for fatty acid profiles. 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. Linear and quadratic contrasts were used to evaluate the effects of feeding duration of CWG and soybean oil on growth and carcass performance. Hot carcass weight was used as a covariate for last rib backfat, 10^{th} rib backfat, loin eye area, and percentage lean.

Results and Discussion

Barrows had increased ($P<0.03$) ADG, ADFI, and F/G compared with gilts. Increasing feeding duration of soybean oil improved (quadratic, $P<0.01$) ADG and F/G. Increasing feeding duration of CWG improved (quadratic, $P<0.02$) F/G. For both fat sources, growth performance appeared to be optimized with a feeding duration of 68 days. Barrows had increased ($P<0.04$) hot carcass weight, last rib backfat, and 10^{th} rib backfat, and decreased ($P<0.01$) loin depth and percentage lean compared with gilts. Increasing feeding duration of CWG and soybean oil increased (quadratic, $P<0.02$) hot carcass weight and dressing percentage with the yield improvement being greater ($P<0.06$) for pigs fed CWG than for pigs fed soybean oil.

Barrows had lower ($P<0.03$) iodine values for jowl fat and backfat and C 18:2 fatty acids than gilts. Barrows also had a greater ($P<0.04$) percentage of saturated fatty acids in the jowl fat and backfat than gilts. Increasing feeding duration of CWG and soybean oil increased (quadratic, $P<0.01$) iodine value of jowl fat and backfat, and C 18:2 fatty acids in jowl fat and backfat. Increasing feeding duration of CWG and soybean oil decreased (quadratic, $P<0.01$) saturated fatty acids in the jowl and backfat. Pigs fed soybean oil had increased

(quadratic, $P<0.01$) iodine values and C 18:2 fatty acids in jowl and backfat, and decreased (quadratic, $P<0.01$) saturated fatty acids in jowl fat and backfat compared with pigs fed CWG.

These results confirm that adding fat to finishing pig diets improves growth performance and feed efficiency. The results also confirm barrows have increased ADG, ADFI, F/G, and backfat, but decreased loin eye area and percentage lean compared with gilts. Increasing feeding duration of fat improves dressing percentage.

Feeding fat increased the softness of fat deposits as measured by iodine value and the percentage of C 18:2 fatty acids, with soybean oil having a more dramatic effect than CWG. Feeding 5% choice white grease, with the Midwestern source used in this trial, for the entire 82-d trial resulted in jowl iodine values acceptable for the Triumph Plant; however, feeding 5% soybean oil for as short of a period as 26 d resulted in jowl iodine value exceeding the maximum threshold even when it was removed from the diet at 56 d before market. Therefore, producers must monitor levels of unsaturated fatty acids in diets for market swine from all dietary sources. Further research evaluating feeding regimes to overcome the large increase in carcass IV when unsaturated fat sources are included in the diet is warranted.

Table 1. Phase 1 Diet Composition (d 0 to 26, as-fed basis)

Ingredients, %	Control	5% CWG	5% Soybean Oil
Corn	72.09	64.14	63.98
Soybean meal (46.5% CP)	25.16	28.11	28.27
Choice white grease	---	5.00	---
Soybean oil	---	---	5.00
Monocalcium P (21% P)	1.05	1.05	1.05
Limestone	0.90	0.90	0.90
Salt	0.35	0.35	0.35
Vitamin premix	0.15	0.15	0.15
Trace mineral premix	0.15	0.15	0.15
L-lysine HCl	0.15	0.15	0.15
Total	100.00	100.00	100.00
Calculated analysis			
Total lysine, %	1.07	1.13	1.14
True ileal digestible amino acids			
Lysine, %	0.95	1.01	1.02
Methionine:lysine ratio, %	28	27	27
Met & cys:lysine ratio, %	57	55	55
Threonine:lysine ratio, %	61	60	60
Tryptophan:lysine ratio, %	19	19	19
ME, kcal/lb	1,507	1,609	1,619
Crude fat, %	3.2	7.9	7.9
Ca, %	0.64	0.65	0.65
P, %	0.60	0.59	0.59
Available P, %	0.29	0.29	0.29
TID lysine:Calorie ratio, g/Mcal ME	2.58	2.58	2.58
Analyzed values			
Dietary fat IV	106.9	53.3	92.1
Dietary IV	34.2	42.1	72.8

Table 2. Phase 2 Diet Composition (d 26 to 54, as-fed basis)

Ingredients, %	Control	5% CWG	5% Soybean Oil
Corn	80.07	72.68	72.48
Soybean meal (46.5% CP)	17.28	19.67	19.87
Choice white grease		5.00	
Soybean oil			5.00
Monocalcium P (21% P)	1.00	1.00	1.00
Limestone	0.90	0.90	0.90
Salt	0.35	0.35	0.35
Vitamin premix	0.13	0.13	0.13
Trace mineral premix	0.13	0.13	0.13
L-lysine HCl	0.15	0.15	0.15
Total	100.00	100.00	100.00
Calculated analysis			
Total lysine, %	0.85	0.90	0.91
True ileal digestible amino acids			
Lysine, %	0.75	0.80	0.81
Methionine:lysine ratio, %	30	29	29
Met & cys:lysine ratio, %	63	60	59
Threonine:lysine ratio, %	62	61	61
Tryptophan:lysine ratio, %	19	19	19
ME, kcal/lb	1,510	1,612	1,622
Crude fat, %	3.4	8.1	8.1
Ca, %	0.61	0.62	0.62
P, %	0.55	0.55	0.55
Available P, %	0.27	0.27	0.27
TID lysine:calorie ratio, g/Mcal ME	2.14	2.14	2.14
Analyzed values			
Dietary fat IV	107.1	64.4	89.9
Dietary IV	36.4	52.2	72.9

Table 3. Phase 3 Diet Composition (d 54 to 82, as-fed basis)[a]

Ingredients, %	Control	5% CWG	5% Soybean Oil
Corn	84.18	77.11	76.87
Soybean meal (46.5% CP)	13.37	15.44	15.68
Choice white grease		5.00	
Soybean oil			5.00
Monocalcium P (21% P)	0.80	0.80	0.80
Limestone	0.90	0.90	0.90
Salt	0.35	0.35	0.35
Vitamin premix	0.13	0.13	0.13
Trace mineral premix	0.13	0.13	0.13
L-lysine HCl	0.15	0.15	0.15
Total	100.00	100.00	100.00
Calculated analysis			
Total lysine, %	0.74	0.78	0.79
True ileal digestible amino acids			
Lysine, %	0.65	0.69	0.70
Methionine:lysine ratio, %	32	31	30
Met & cys:lysine ratio, %	67	63	63
Threonine:lysine ratio, %	64	62	62
Tryptophan:lysine ratio, %	19	19	19
ME, kcal/lb	1,514	1,616	1,626
Crude fat, %	3.5	8.2	8.2
Ca, %	0.56	0.57	0.57
P, %	0.50	0.49	0.49
Available P, %	0.22	0.22	0.22
TID lysine:calorie ratio, g/Mcal ME	1.85	1.85	1.85
Analyzed values			
Dietary fat IV	106.6	60.9	85.2
Dietary IV	37.3	49.9	69.9

Figure 1. Treatment Structure

	Day of Trial			
Treatment	0 to 26	26 to 54	54 to 68	68 to 82
Control	Control	Control	Control	Control
CWG[1] d 0 to 26	5% CWG	Control	Control	Control
CWG d 0 to 54	5% CWG	5% CWG	Control	Control
CWG d 0 to 68	5% CWG	5% CWG	5% CWG	Control
CWG d 0 to 82	5% CWG	5% CWG	5% CWG	5% CWG
Soybean Oil d 0 to 26	5% Soy Oil	Control	Control	Control
Soybean Oil d 0 to 54	5% Soy Oil	5% Soy Oil	Control	Control
Soybean Oil d 0 to 68	5% Soy Oil	5% Soy Oil	5% Soy Oil	Control
Soybean Oil d 0 to 82	5% Soy Oil	5% Soy Oil	5% Soy Oil	5% Soy Oil

[1]Choice white grease.

Table 4. Effects of Choice White Grease and Soybean Oil and Feeding Duration on Growth Performance[a]

													Probability, *P*<					
														Feeding duration				
Fat source:	Control	5 % Choice white grease				5 % Soybean oil							Fat	CWG		Soybean oil	
Feeding duration, d:	0	26	54	68	82	26	54	68	82	Barrows	Gilts	SE	Gender	Source	Linear	Quad	Linear	Quad
D 0 to 82																		
ADG, lb	2.18	2.24	2.27	2.28	2.27	2.28	2.29	2.38	2.35	2.36	2.21	0.071	0.01	0.07	0.42	0.14	0.32	0.01
ADFI, lb	6.93	7.00	6.71	6.65	6.52	7.28	6.49	6.79	6.86	6.35	5.72	0.090	0.01	0.54	0.81	0.23	0.93	0.79
F/G	2.82	2.72	2.66	2.60	2.61	2.66	2.67	2.54	2.54	2.70	2.59	0.072	0.03	0.30	0.47	0.02	0.37	0.01

[a]Total of 144 pigs (initial weight 96.7 lbs) with 2 pigs per pen and eight replications per treatment.

Table 5. Effects of Choice White Grease and Soybean Oil and Feeding Duration on Carcass Characteristics[a]

													Probability, *P*<					
														Feeding duration				
Fat source:	Control	5 % Choice white grease				5 % Soybean oil							Fat	CWG		Soybean oil	
Feeding duration, d:	0	26	54	68	82	26	54	68	82	Barrows	Gilts	SE	Gender	Source	Linear	Quad	Linear	Quad
Carcass weight, lb	199.5	201.5	207.2	209.0	207.7	203.7	208.5	211.7	211.3	211.6	201.8	0.056	0.04	0.22	0.63	0.02	0.56	0.01
Yield, %	72.5	72.1	73.3	73.5	73.3	71.8	73.2	72.4	73.1	72.7	72.8	0.015	0.72	0.06	0.32	0.01	0.18	0.05
Last rib bf, in	0.96	0.91	0.91	1.06	0.88	0.90	0.87	0.93	1.04	1.02	0.86	0.204	0.04	0.80	0.64	0.99	0.12	0.58
10^{th} rib bf, in	0.70	0.69	0.70	0.72	0.70	0.69	0.73	0.68	0.79	0.79	0.63	0.167	0.01	0.43	0.72	0.72	0.24	0.97
Loin depth, in	2.22	2.37	2.29	2.36	2.37	2.26	2.29	2.43	2.36	2.28	2.29	0.079	0.01	0.51	0.30	0.84	0.95	0.17
Lean, %	54.5	55.5	55.0	54.9	55.2	55.1	54.7	55.7	53.7	53.6	56.4	0.037	0.01	0.35	0.46	0.69	0.31	0.58
Backfat IV	63.3	64.8	67.7	68.0	68.8	67.6	77.2	81.2	84.3	69.6	72.8	0.111	0.02	0.01	0.60	0.01	0.49	0.01
Jowl IV	67.1	68.8	70.3	70.2	71.5	73.3	79.1	80.9	82.0	72.8	74.3	0.077	0.03	0.01	0.56	0.01	0.01	0.01
Backfat 18:2, %	11.2	12.9	12.7	12.9	13.7	15.8	19.2	21.2	21.8	16.0	17.9	0.312	0.01	0.01	0.44	0.04	0.40	0.01
Jowl 18:2%	12.0	13.1	14.1	14.2	14.5	15.1	21.0	23.9	25.8	15.0	16.0	0.263	0.04	0.01	0.63	0.01	0.01	0.01
Backfat saturated, %	34.7	34.1	32.8	32.9	32.2	32.8	31.1	30.9	30.6	37.4	35.8	0.079	0.04	0.01	0.96	0.01	0.72	0.01
Jowl saturated, %	39.7	39.3	37.0	36.8	36.0	38.6	34.7	33.7	32.7	32.9	32.1	0.053	0.04	0.01	0.60	0.01	0.01	0.01

[a]Total of 144 pigs were used for carcass data collection and analysis.