EFFECTS OF INCREASING ADDED CHOICE WHITE GREASE IN CORN AND SORGHUM-BASED DIETS ON GROWTH PERFORMANCE AND FAT QUALITY CHARACTERISTICS OF FINISHING PIGS[1]

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Summary

One hundred twenty crossbred barrows and gilts (TR4 × 1050) with an initial weight of 119.9 lb were used in an 83-d experiment to evaluate the effects of increasing added fat to corn or sorghum-based diets on growth performance and fat quality characteristics of finishing pigs. Treatments were arranged in a 2 × 2 × 3 factorial based on grain source (corn or sorghum), gender, and added fat (0, 2.5, or 5% choice white grease, CWG). At the end of the trial, jowl fat and backfat samples were collected. Pigs fed sorghum-based diets had increased (P<0.01) ADG compared with pigs fed corn-based diets. Pigs fed increasing CWG had increased (P<0.01) ADG. Pigs fed corn-based diets tended to have improved (P<0.06) dressing percentage, 10th rib BF, and percentage lean when compared with pigs fed sorghum-based diets. Barrows tended to have greater (P<0.06) dressing percentage and decreased (P<0.07) percentage lean when compared to gilts. Pigs fed increasing CWG had increased (P<0.02) 10th rib backfat, tended to have increased (P<0.08) hot carcass weight, and tended to have decreased (P<0.07) percentage lean. There was a fat level by grain source interaction (P<0.03) for percent C 18:2 fatty acids and iodine value in jowl fat. The interaction was due to the greatest increase in IV and percentage C 18:2 fatty acids occurring when CWG was increased from 2.5 to 5% for corn-based diets, while the greatest increase was from 0 to 2.5% CWG for sorghum-based diets. Despite this interaction, adding CWG increased (linear, P<0.02) percentage C 18:2 fatty acids and iodine value in jowl fat. Pigs fed corn-based diets had increased (P<0.01) iodine values and percentage C 18:2 fatty acids in jowl fat and backfat compared with pigs fed sorghum-based diets. Increasing dietary CWG increased (P<0.01) iodine value in jowl fat and backfat, increased (P<0.01) percentage C 18:2 fatty acids in backfat, tended to increase (P<0.06) percentage 18:2 fatty acids in jowl fat, and decreased (P<0.01) percentage saturated fatty acids in jowl fat and backfat. In summary, substituting sorghum for corn in diets for finishing pigs can be an effective way to reduce iodine value without affecting growth.

(Key words: corn, fat, feed ingredients, pork quality, sorghum.)

Introduction

Considerable research has shown improvements in feed efficiency and average

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daily gain from feeding added fat to finishing pigs. Composition of carcass fat, however, is altered when fat is included in diets, which may have implications from a processor acceptance standpoint. Iodine Value is a measure of the degree of unsaturation of a fat. Carcass iodine value, an indicator of carcass firmness, must be further researched to know the full carcass quality implications from feeding different fat sources for various time periods. Currently, Triumph Foods, St. Joseph, MO has set a maximum jowl iodine value of 73. Our previous research has demonstrated that including an unsaturated fat source in the diet during any portion of the finishing phase can result in iodine values above 73. Sorghum is often an economical replacement for corn in swine diets in Kansas. Additionally, sorghum has lower oil content than corn, which may lead to a lower carcass iodine value. With this in mind, the objective of this trial was to evaluate the effects adding fat to corn and sorghum diets would have on growth performance and fat quality characteristics of finishing pigs.

Procedures

One hundred twenty crossbred barrows and gilts, (TR4 × 1050) with an initial weight of 119.9 lb were used in an 83-d experiment. Pigs were blocked by weight and allotted to one of six treatments. Treatments were arranged in a 2 × 3 factorial based on grain source (corn or sorghum) and added fat (0, 2.5, or 5% choice white grease). Prior to being placed on test, all pigs were fed a corn-soybean meal-based diet. Diets were formulated to be fed in three phases from d 0 to 22, 22 to 53, and 53 to 83 to correspond with approximate weight ranges of 90 to 150, 150 to 210, and 210 to 270 lb. A constant TID lysine:ME ratio was maintained by altering the corn and soybean meal level in the basal diet when adding the fat to the diets.

There were two pigs per pen with ten replicate pens per treatment. Pigs were housed in an environmentally-controlled finishing barn with 4 ft × 4 ft pens with totally slatted flooring. Each pen was equipped with a one-hole dry self-feeder and nipple waterer to allow *ad libitum* access to feed and water. Pigs and feeders were weighed on d 14, 22, 39, 53, 67, 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 and backfat 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 as 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 increasing of choice white grease on growth and carcass performance. Hot carcass weight was used as a covariate for 10th rib backfat, last rib backfat, loin depth, and percentage lean.

Results and Discussion

Pigs fed sorghum-based diets had increased (P<0.01) ADG compared with pigs fed corn-based diets. The increase in ADG was due to a numerical (P = 0.15) increase in ADFI for pigs fed sorghum-based diets. Also,

pigs fed increasing CWG had improved (P<0.01) ADG.

Pigs fed corn-based diets tended to have improved (P<0.09) dressing percentage, 10th rib backfat (BF), and percentage lean when compared to pigs fed sorghum-based diets. Barrows tended to have greater (P<0.06) dressing percentage and decreased (P<0.07) percentage lean when compared to gilts. Increasing CWG increased (P<0.02) 10th rib backfat, tended to increase (P<0.08) hot carcass weight, and tended to decrease (P<0.07) percentage lean.

There was a fat level by grain source interaction (P<0.03) for percent C 18:2 fatty acids and iodine value in jowl fat. Adding CWG increased iodine value and percentage C 18:2 fatty acids in jowl fat for pigs fed sorghum and corn-based diets; however, the greatest increase was between 0 and 2.5% CWG for sorghum-based diets and between 2.5 and 5% CWG for corn-based diets.

Despite this interaction, pigs fed corn-based diets had increased (P<0.01) iodine values and percentage C 18:2 fatty acids in jowl fat and backfat compared with pigs fed sorghum-based diets. Increasing dietary CWG increased (P<0.01) iodine value in jowl fat and backfat, increased (P<0.01) percentage C 18:2 fatty acids in backfat, tended to increase (P<0.06) percentage 18:2 fatty acids in jowl fat, and decreased (P<0.01) percentage saturated fatty acids in jowl fat and backfat.

These results confirm that added dietary fat improves pig growth performance. Unexpectedly, pigs fed sorghum-based diets had improved ADG compared to pigs fed corn-based diets with the response due to increased feed consumption for pigs fed sorghum-based diets. Typically, we would expect similar ADG and slightly poorer F/G for pigs fed sorghum based diets compared with corn-based diets. Pigs fed corn-based diets had improved dressing percentage, reduced 10th rib fat and improved percentage lean compared with pigs fed sorghum-based diets. The results also demonstrate the expected lower percentage lean for barrows compared with gilts.

Our findings confirm that adding fat to finishing pig diets increases iodine value and percentage C 18:2 fatty acids, and reduce percentage saturated fatty acids in jowl fat and backfat. However, the CWG used in this trial from our Midwestern source resulted in jowl iodine values below the maximum level of 73 g/100g established by the Triumph Foods. This experiment demonstrated that compared to corn, feeding sorghum decreases iodine value. Therefore, sorghum could potentially be used to replace corn when iodine values approach the maximum level.

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

	Corn			Sorghum		
Ingredients Added fat:	0%	2.5%	5%	0%	2.5%	5%
Corn	72.18	68.18	64.19	- - -	- - -	- - -
Sorghum	- - -	- - -	- - -	72.25	68.25	64.20
Soybean meal (46.5% CP)	25.23	26.70	28.14	25.25	26.73	28.25
Choice white grease	- - -	2.50	5.00	- - -	2.50	5.00
Monocalcium P (21% P)	1.03	1.05	1.10	0.93	0.98	1.00
Limestone	0.85	0.85	0.85	0.85	0.85	0.85
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.10	0.10	0.10	0.10	0.10	0.10
Trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
L-lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
DL-methionine	0.02	0.02	0.02	0.02	0.02	0.02
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
Total lysine, %	1.07	1.10	1.13	1.04	1.08	1.11
True ileal digestible amino acids						
Lysine, %	0.95	0.98	1.01	0.93	0.97	1.00
Methionine:lysine ratio, %	29	29	28	30	29	28
Met & cys:lysine ratio, %	59	58	56	58	57	56
Threonine:lysine ratio, %	61	60	60	64	63	62
Tryptophan:lysine ratio, %	19	19	19	22	22	22
ME, kcal/lb	1,510	1,561	1,611	1,485	1,537	1,589
Crude fat, %	3.2	5.6	7.9	2.5	4.9	7.3
Ca, %	0.62	0.63	0.64	0.60	0.61	0.62
P, %	0.59	0.60	0.60	0.58	0.59	0.59
Available P, %	0.28	0.29	0.30	0.28	0.29	0.29
TID Lys:Cal ratio, g/Mcal ME	2.58	2.58	2.58	2.58	2.58	2.58
Analyzed values						
Dietary fat IV	111.14	92.39	85.71	108.65	87.88	71.32
Dietary IV	35.56	51.37	72.62	26.88	42.88	51.96

[a]Diets fed in meal form from d 0 to 22.

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

		Corn			Sorghum		
Ingredients	Added fat:	0%	2.5%	5%	0%	2.5%	5%
Corn		80.26	76.53	72.81	- - -	- - -	- - -
Sorghum		- - -	- - -	- - -	80.10	76.35	72.60
Soybean meal (46.5% CP)		17.27	18.47	19.66	17.53	18.73	19.97
Choice white grease		- - -	2.50	5.00	- - -	2.50	5.00
Monocalcium P (21% P)		0.93	0.95	0.98	0.83	0.85	0.90
Limestone		0.85	0.85	0.85	0.85	0.85	0.85
Salt		0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix		0.10	0.10	0.10	0.10	0.10	0.10
Trace mineral premix		0.10	0.10	0.10	0.10	0.10	0.10
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	0.90	0.82	0.85	0.88
True ileal digestible amino acids							
Lysine, %		0.75	0.78	0.80	0.74	0.76	0.79
Methionine:lysine ratio, %		30	30	29	31	30	29
Met & cys:lysine ratio, %		63	61	60	62	60	59
Threonine:lysine ratio, %		63	62	61	67	66	65
Tryptophan:lysine ratio, %		19	19	19	23	23	22
ME, kcal/lb		1,513	1,564	1,614	1,485	1,537	1,589
Crude fat, %		3.4	5.8	8.1	2.6	5.0	7.4
Ca, %		0.58	0.58	0.59	0.56	0.57	0.58
P, %		0.54	0.54	0.54	0.53	0.53	0.54
Available P, %		0.25	0.26	0.26	0.25	0.25	0.26
TID Lys:Cal ratio, g/Mcal ME		2.14	2.14	2.14	2.14	2.14	2.14
Analyzed values							
Dietary fat IV		113.97	94.99	84.76	106.83	90.83	83.71
Dietary IV		38.75	54.73	68.95	21.76	45.38	61.98

[a]Diets fed in meal form from d 22 to 53.

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

Ingredients	Added fat:	Corn			Sorghum		
		0%	2.5%	5%	0%	2.5%	5%
Corn		84.18	80.54	76.98	- - -	- - -	- - -
Sorghum		- - -	- - -	- - -	83.90	80.35	76.75
Soybean meal (46.5% CP)		13.44	14.56	15.60	13.82	14.82	15.91
Choice white grease		- - -	2.50	5.00	- - -	2.50	5.00
Monocalcium P (21% P)		0.88	0.90	0.93	0.78	0.83	0.85
Limestone		0.80	0.80	0.80	0.80	0.80	0.80
Salt		0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix		0.10	0.10	0.10	0.10	0.10	0.10
Trace mineral premix		0.10	0.10	0.10	0.10	0.10	0.10
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	0.77	0.79	0.72	0.74	0.77
True ileal digestible amino acids							
Lysine, %		0.65	0.68	0.70	0.64	0.66	0.69
Methionine:lysine ratio, %		32	31	30	33	32	31
Met & cys:lysine ratio, %		66	65	63	65	63	62
Threonine:lysine ratio, %		64	63	62	69	67	66
Tryptophan:lysine ratio, %		19	19	19	23	23	23
ME, kcal/lb		1,515	1,566	1,617	1,486	1,538	1,590
Crude fat, %		3.5	5.9	8.2	2.6	5.1	7.5
Ca, %		0.54	0.54	0.55	0.52	0.53	0.54
P, %		0.51	0.51	0.52	0.50	0.51	0.51
Available P, %		0.24	0.24	0.25	0.23	0.24	0.25
TID Lys:Cal ratio, g/Mcal ME		1.85	1.85	1.85	1.85	1.85	1.85
Analyzed values							
Dietary fat IV		120.3	99.03	84.03	94.62	85.38	83.21
Dietary IV		42.11	58.03	69.21	24.99	43.14	62.11

[a]Diets fed in meal form from d 53 to 83.

Table 4. Effects of Adding Fat to Corn and Sorghum-based Diets on Growth Performance[a]

										Probability, *P*<				
	Corn			Sorghum			Fat Level SE	Source SE	Gender SE			Fat level		Source × Fat Level
Added CWG	0%	2.5%	5%	0%	2.5%	5%				Source	Gender	Linear	Quad	
D 0 to 83														
ADG, lb	1.97	2.04	2.13	2.10	2.18	2.23	0.17	0.14	0.14	0.01	0.89	0.01	0.98	0.89
ADFI, lb	5.62	5.75	5.57	5.88	5.82	6.02	0.04	0.04	0.04	0.15	0.49	0.51	0.23	0.61
F/G	2.85	2.82	2.62	2.81	2.67	2.70	0.07	0.05	0.06	0.90	0.49	0.18	0.16	0.68

[a]A total of 120 pigs (initial weight 119.9 lbs) with 2 pigs per pen and 10 replicates per treatment.

Table 5. Main Effects of Adding Fat to Corn and Sorghum-based Diets on Growth Performance[a]

											Probability, *P*<				
	Fat Level			Source		Gender		Fat Level SE	Source SE	Gender SE			Fat level		Source × Fat Level
Added CWG	0%	2.5%	5%	Corn	Sorghum	Barrows	Gilts				Source	Gender	Linear	Quad	
D 0 to 83															
ADG, lb	2.03	2.11	2.19	2.05	2.17	2.12	2.09	0.17	0.14	0.14	0.01	0.89	0.01	0.98	0.89
ADFI, lb	5.72	5.79	5.84	5.65	5.91	5.94	5.62	0.04	0.04	0.04	0.15	0.49	0.51	0.23	0.61
F/G	2.81	2.75	2.67	2.76	2.73	2.81	2.69	0.07	0.05	0.06	0.90	0.49	0.18	0.16	0.68

[a]A total of 120 pigs (initial weight 119.9 lbs) with 2 pigs per pen and 20 replicates per fat level treatment, and 30 per gender treatment.

Table 6. Effects of Adding Fat to Corn and Sorghum-based Diets on Carcass Performance[a]

										Probability, P<				
	Corn			Sorghum								Fat level		
Item Added fat, %	0%	2.5%	5%	0%	2.5%	5%	Fat Level SE	Source SE	Gender SE	Source	Gender	Linear	Quad	Source × Fat Level
Hot carcass wt, lb	206.9	213.9	217.3	212.5	220.6	221.2	2.68	2.14	2.14	0.46	0.64	0.08	0.92	0.34
Dress, %	73.0	73.6	73.3	72.2	72.8	72.4	0.37	0.30	0.32	0.06	0.06	0.28	0.36	0.91
10th rib fat, in [b]	0.65	0.72	0.71	0.72	0.72	0.81	0.06	0.05	0.06	0.06	0.15	0.02	0.77	0.06
Loin depth, in [b]	2.40	2.50	2.48	2.41	2.55	2.45	0.93	0.74	0.74	0.98	0.53	0.52	0.03	0.80
Last rib fat, in [b]	0.88	0.99	0.98	0.95	0.96	1.00	0.06	0.03	0.03	0.83	0.69	0.18	0.61	0.44
Lean, % [b]	53.9	53.6	53.4	53.2	53.5	52.3	0.28	0.26	0.22	0.09	0.07	0.07	0.13	0.13
Backfat iodine value	63.77	66.55	67.21	60.96	65.95	64.68	0.55	0.45	0.45	0.01	0.50	0.01	0.01	0.27
Jowl fat iodine value	69.24	69.30	72.24	66.22	69.64	68.87	0.57	0.46	0.46	0.01	0.83	0.01	0.66	0.03
Backfat C 18:2, %	13.81	14.83	14.52	11.06	13.29	12.50	0.31	0.25	0.25	0.01	0.88	0.02	0.01	0.37
Jowl fat C 18:2, %	14.57	14.13	15.35	11.97	13.85	13.04	0.32	0.26	0.26	0.01	0.83	0.06	0.47	0.02
Backfat saturated fatty acids, %	41.27	39.15	38.00	41.77	38.34	38.92	0.41	0.34	0.34	0.54	0.36	0.01	0.03	0.26
Jowl fat saturated fatty acids., %	36.21	35.56	33.49	36.98	35.02	34.87	0.37	0.29	0.30	0.14	0.97	0.01	0.89	0.14

[a]Total of 120 pigs (initial weight 119.9 lbs) with 2 pigs per pen and 10 replicates per treatment.
[b]Hot carcass weight used as a covariate.

Table 7. Main Effects of Adding Fat to Corn and Sorghum-based Diets on Carcass Performance[a]

	Fat Level			Source		Gender					Probability, P<				
								Fat Level	Source	Gender			Fat level		Source ×
Added CWG	0%	2.5%	5%	Corn	Sorghum	Barrows	Gilts	SE	SE	SE	Source	Gender	Linear	Quad	Fat Level
Hot carcass wt, lb	210.7	214.3	217.2	212.7	215.2	214.8	213.2	2.68	2.14	2.14	0.46	0.64	0.08	0.92	0.34
Dress, %	72.5	73.2	73.1	73.3	72.5	73.4	72.4	0.37	0.30	0.32	0.06	0.06	0.28	0.36	0.91
10th rib fat, in [b]	0.68	0.72	0.78	0.70	0.76	0.75	0.70	0.06	0.05	0.06	0.06	0.15	0.02	0.77	0.06
Loin depth, in [b]	2.41	2.54	2.45	2.47	2.47	2.45	2.479	0.93	0.74	0.74	0.98	0.53	0.52	0.03	0.80
Last rib fat, in [b]	0.91	0.98	1.00	0.96	0.97	0.97	0.95	0.06	0.03	0.03	0.83	0.69	0.18	0.61	0.44
Lean, % [b]	53.6	53.6	52.6	53.6	52.9	52.9	53.6	0.28	0.26	0.22	0.09	0.07	0.07	0.13	0.13
Backfat iodine value	62.54	66.24	65.94	65.82	63.86	64.70	64.96	0.55	0.45	0.45	0.01	0.50	0.01	0.01	0.27
Jowl fat iodine value	68.03	69.47	70.48	70.29	68.29	69.51	69.13	0.57	0.46	0.46	0.01	0.83	0.01	0.66	0.03
Backfat C 18:2, %	12.50	14.02	13.49	14.37	12.29	13.32	13.30	0.31	0.25	0.25	0.01	0.88	0.02	0.01	0.37
Jowl fat C 18:2, %	13.39	13.99	14.19	14.69	12.99	13.95	13.76	0.32	0.26	0.26	0.01	0.83	0.06	0.47	0.02
Backfat saturated fatty acids, %	41.38	38.72	38.46	39.49	39.67	39.74	39.41	0.41	0.34	0.34	0.54	0.36	0.01	0.03	0.26
Jowl fat saturated fatty acids., %	36.36	35.29	34.26	35.05	35.60	35.24	35.38	0.37	0.29	0.30	0.14	0.97	0.01	0.89	0.14

[a]A total of 120 pigs (initial weight 119.9 lbs) with 2 pigs per pen and 20 replicates per fat level treatment, and 30 per gender treatment.
[b] Hot carcass weight used as a covariate.