Kansas Agricultural Experiment Station Research Reports

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

Article 747

2000

Effects of free fatty acid concentrations in choice white grease on growth performance and nutrient digestibility in weanling pigs

Robert H. Hines

H Cao

C A. Maloney

See next page for additional authors

Effects of free fatty acid concentrations in choice white grease on growth performance and nutrient digestibility in weanling pigs

Authors

Robert H. Hines, H Cao, C A. Maloney, D W. Dean, D J. Lee, J S. Park, Joel M. DeRouchey, and Joe D. Hancock

EFFECTS OF FREE FATTY ACID CONCENTRATIONS IN CHOICE WHITE GREASE ON GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY IN WEANLING PIGS

J. M. DeRouchey, J. D. Hancock, R. H. Hines, H. Cao, C. A. Maloney, D. W. Dean, D. J. Lee, and J. S. Park

Summary

As much as 53% free fatty acids in choice white grease did not adversely affect piglet performance. Thus, concentration of free fatty acids, if they are not otherwise damaged or rancid, is not an acceptable measure of fat quality.

(Key Words: Weanling Pigs, Fat Quality, Free Fatty Acids)

Introduction

Using fat to improve growth performance in nursery pigs is a common practice. However, research about fat utilization in young pigs has been focused on the effects of unsaturated:saturated fatty acid ratios, chain length of the fatty acids, and age of pigs when fat is added to the diet. Thus, few data are available about the effects of "fat quality" (e.g., free fatty acids) and growth performance in pigs. Our objective was to determine the effects of free fatty acids in choice white grease on growth performance and nutrient digestibility in weanling pigs.

Procedures

One hundred twenty five weanling pigs (lines C 22 × 326, PIC, Frankiln KY) with an average initial BW of 13.7 lb were used in a 33-d growth assay. The pigs were weaned and allotted by BW, sex, and ancestry to five treatments. Initial BW was used as the blocking criterion. The diets (Table 1) were formulated to 1.70% lysine for d 0 to 5, 1.55% lysine for d 5 to 19, and 1.40% lysine for d 19 to 33. They also met or exceeded all nutrient requirements as defined by NRC (1998). Treatments were a corn-soybean meal-based diet with no added fat; 6% choice white grease; and 6% choice white grease that had been heated at 95°F and treated with 872, 1,175, and 2,248 lipase units/g of fat. The choice white grease allotted for lipase addition was divided in three barrels (55 gal capacity) with 65 lb per barrel, and heaters were attached to maintain a constant temperature. Fat treated with lipase was mixed with water, the lipase was added, and the mixture was agitated for 12 h. The mixture was allowed to stand for 24 h (for separation of the fat and water), and the water was pumped from the bottom of the barrel.

Pigs for the experiment were housed in an environmentally controlled building with a self-feeder and nipple water in each pen to allow ad libitum consumption of feed and water. Pigs and feeders were weighed on d 5, 19, and 33 to allow calculation of ADG, ADFI, and gain/feed.

Pen was the experimental unit. The GLM procedures of SAS were used for all statistical analyses. Polynomial regression was used to determine the shape of the response to increasing free fatty acids in the choice white grease.

Results and Discussion

Chemical analyses of the fat treatments indicated that percentage of free fatty acids increased (from 2 to 53%) as lipase addition to the fat was increased from none to 2,248 lipase units/g of fat (Table 2). Peroxide and p-anisidine values and percentage insoluble impurities and unsaponifiable matter were unchanged as lipase treatment was increased. Also, fatty acid composition, iodine value, and U/S ratio remained virtually unchanged

as indicated by enzyme hydrolysis of the choice white grease. However, moisture increased as the extent of lipase treatment was increased, indicating that less water separation from the choice white grease was possible as free fatty acids increased.

In the growth assay (Table 3), no differences in ADG, ADFI, or F/G were detected from d 0 to 5 (P>.30) or d 5 to 19 (P>.11). However, for d 19 and 33, ADG tended to increase (P<.06) and F/G decreased (P<.01) with the fat-added treatments versus the control.

Overall, ADG was not affected (P>.15), but F/G was improved (P<.04) with the addition of fat to the diet. No differences occurred in ADG or F/G as concentration of free fatty acids increased (P>.16). Also, no differences were observed in digestibility of DM or GE among the dietary treatments (P>.14). Also, the digestibility of long-chain unsaturated fatty acids, long-chain saturated fatty acids, and total fat were greater (P<.001) for the fat-added treatments compared to control, but fatty acid digestibility was not affected (P>.17) by concentration of free fatty acids in the diet.

In conclusion, as much as 53% free fatty acids in choice white grease did not adversely affect piglet performance. Thus, concentration of free fatty acids, if they are not otherwise damaged or rancid is not an acceptable measure of fat quality.

Table 1. Compositions of Diets[a]

Item, %	d 0 to 5		d 5 to 19		d 19 to 33	
	Control	Fat Added	Control	Fat Added	Control	Fat Added
Corn	22.84	22.84	44.10	44.10	47.81	47.81
Soybean meal (46.5% CP)	26.36	26.36	31.52	31.52	41.86	41.86
Dried whey	20.00	20.00	10.00	10.00	—	—
Lactose	10.00	10.00	—	—	—	—
Cornstarch	6.00	—	6.00	—	6.00	—
Choice white grease[b]	—	6.00	—	6.00	—	6.00
Spray-dried wheat gluten	4.00	4.00	—	—	—	—
Spray-dried plasma protein	4.00	4.00	1.00	1.00	—	—
Fish meal (menhaden)	2.00	2.00	3.00	3.00	—	—
Monocalcium phosphate (21%)	1.28	1.28	.85	.85	1.32	1.32
Limestone	.89	.89	.84	.84	1.17	1.17
L-lysine·HCl	.32	.32	.25	.25	.05	.05
D,L-methionine	.19	.19	.14	.14	.05	.05
L-threonine	.08	.08	.10	.10	—	—
Salt	.25	.25	.30	.30	.35	.35
Vitamin premix	.25	.25	.25	.25	.25	.25
Mineral premix	.15	.15	.15	.15	.15	.15
Antibiotic[c]	1.00	1.00	1.00	1.00	1.00	1.00
Zinc oxide	.32	.32	.25	.25	—	—
Copper sulfate	—	—	—	—	.09	.09
Chromic oxide	—	—	.25	.25	—	—

[a]Diets were formulated to: 1.7% lysine, .9% Ca, and .8% P for d 0 to 5; 1.55% lysine, .8% Ca, and .7% P for d 5 to 19; and 1.4% lysine, .8% Ca, and .7% P for d 19 to 33.

[b]Choice white grease with 0, 872, 1,752, and 2,248 lipase units/gram of fat.

[c]Provided 150 g of apramycin per ton of feed for d 0 to 19 and 50 g of carbox per ton of feed for d 19 to 33.

Table 2. Chemical Analysis of Choice White Grease

	Lipase Units/G of Choice White Grease			
Item	0	872	1,752	2,248
Free fatty acids, %	2	18	35	53
Peroxide value, mEq/kg	1	1	1	1
p-anisidine value	5.2	4.9	5.0	5.6
Total M.I.U., %[a]	1.17	2.56	2.85	3.34
Moisture, %	.14	1.58	1.85	2.38
Insoluble impurities, %	.01	.01	.03	.02
Unsaponifiable matter, %	1.02	.97	.97	.94
Iodine value	61.2	61.2	60.5	62.7
Unsaturated:saturated ratio	1.49	1.50	1.44	1.52
Fatty acids, % of sample[b]				
C8:0[c]	.00	.00	.00	.00
C10:0	.00	.00	.00	.00
C12:0	.26	.24	.24	.23
C14:0	2.07	2.12	2.11	2.03
C16:0	25.48	25.48	25.78	25.12
C16:1	3.23	3.33	3.19	3.40
C18:0	11.80	11.63	12.31	11.73
C18:1	48.06	48.02	47.11	47.28
C18:2	7.33	7.31	7.33	8.14
C18:3	.57	.57	.63	.77

[a]Moisture, insoluble impurities, and unsaponifiable matter.

[b]Fatty acids determined by gas chromatography as derivatized fatty acid methyl esters.

[c]Number of carbon atoms and double bonds designated to the left and right of colon, respectively.

Table 3. Effects of Free Fatty Acid Concentration on Growth Performance and Digestibility of Nutrients in Weanling Pigs[a]

Item	Free Fatty Acid Concentration, %					Probability			
							Free Fatty Acid Effects		
	No Added Fat	2	18	35	53	SE	No Added Fat vs Others	Linear	Quadratic	Cubic
d 0 to 5										
ADG, lb	.58	.59	.62	.61	.65	.04	—[c]	—	—	—
ADFI, lb	.55	.56	.59	.58	.60	.04	—	—	—	—
F/G	.95	.95	.96	.96	.92	.05	—	—	—	—
d 5 to 19										
ADG, lb	.86	.84	.87	.81	.83	.04	—	—	—	—
ADFI, lb	1.32	1.24	1.29	1.28	1.28	.03	.11	—	—	—
F/G	1.53	1.47	1.48	1.58	1.54	.05	—	—	—	—
d 19 to 33										
ADG, lb	1.39	1.49	1.44	1.44	1.50	.03	.06	—	.11	—
ADFI, lb	2.31	2.13	2.20	2.24	2.23	.06	.11	—	—	—
F/G	1.66	1.43	1.53	1.56	1.49	.05	.01	—	.09	—
d 0 to 33										
ADG, lb	1.04	1.08	1.07	1.05	1.09	.02	—	—	—	—
ADFI, lb	1.62	1.51	1.57	1.58	1.58	.02	.02	.04	—	—
F/G	1.56	1.40	1.47	1.50	1.45	.04	.04	—	—	—
Apparent Digestibility, %										
DM	79.9	77.3	78.1	80.0	79.1	1.0	—	.14	—	—
GE	77.6	75.174.6	76.9	78.6	76.3	1.6	—	—	—	—
N	76.4	73.3	76.3	78.5	76.0	1.3	—	—	.10	—
Total fat[b]	66.4		74.1	77.7	74.7	2.2	.001	—	—	—
Long-chain unsaturated		77.9								
	69.7		79.2	81.7	79.4	2.2	.001	—	—	—
fatty acids		62.8								
Long-chain saturated	51.0	89.4	63.3	68.9	65.2	3.0	.001	—	—	—
fatty acids	91.8		89.9	91.5	89.4	.9	.11	—	—	—
Medium-chain fatty acids										

[a]A total of 125 pigs (five pigs per pen and five pens per treatment) with an average initial BW of 13.7 lb.

[b]Determined by gas chromatography as derivatized fatty acid methyl esters.

[c]P>.15.