INFLUENCE OF GLYCEROL AND ADDED FAT ON FINISHING PIG PERFORMANCE[1]

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

Summary

A 28-d study was conducted to determine the influence of dietary glycerol on grow-finish pig performance. The experiment was conducted at a commercial swine research facility in southwest Minnesota. A total of 1,093 pigs (initially 171.3 lb, PIC) were blocked by weight and randomly allotted to 1 of 6 dietary treatments. Pigs were fed corn-soybean meal-based diets. The treatments were arranged in a 2 × 3 factorial with main effects of glycerol (0, 2.5, or 5%) and added fat (0 or 6%). Overall (d 0 to 28), there was a fat × glycerol interaction ($P < 0.04$) for ADFI. When 5% glycerol was added to diets without added fat, ADFI decreased; however, ADFI did not change when glycerol was added to diets containing 6% added fat.

Pigs fed diets with added fat had improved ($P < 0.01$) ADG and F/G compared with pigs fed diets with no added fat. Increasing glycerol decreased ADG (linear, $P < 0.02$) and ADFI (linear, $P < 0.04$) and tended (linear, $P < 0.08$) to worsen F/G, a result of the negative effect of adding glycerol to diets without fat. In conclusion, 6% added fat improved ADG and F/G, but the glycerol used in this study decreased ADG and ADFI when added to diets without added fat.

Key words: fat, glycerol

Introduction

According to the National Biodiesel Board, in October 2007 there were 105 operating biodiesel production facilities and 77 facilities in the planning or construction stage in the United States. If all of these plants were built, estimated U.S. biodiesel production capacity would exceed 2.5 billon gal. This level of production would produce nearly 1.3 million tons of glycerol, the primary coproduct of biodiesel production. There has been much interest in utilizing crude glycerol as a feed ingredient in animal diets to reduce diet costs. However, little is known about glycerol's nutritional value. Previous research at Kansas State University found that feeding glycerol to nursery pigs increased ADG and ADFI and slightly improved F/G. In addition, dietary fat has continually shown improved ADG and F/G in grow-finish performance. However, because fat and glycerol are both in liquid form, questions exist regarding whether their effects on performance will be additive when included in the diet. Therefore, the objective of this study was to evaluate the effects of glycerol added to diets with or without added fat on growth performance in finishing pigs.

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

Procedures

Procedures used in these experiments were approved by the Kansas State University (KSU) Institutional Animal Care and Use Committee. The experiment was conducted at a commercial research facility in southwest Minnesota. The facility had a totally slatted floor, and each pen was equipped with a 4-hole dry self-feeder and 1 cup waterer. The facility was a double-curtain-sided, deep-pit barn that operated on natural ventilation during the summer and mechanical ventilation during the winter. The experiment was conducted in August.

A total of 1,093 pigs (initially 171.3 lb, PIC 337 × 1050) were used in the 28-d study. Each pen contained 24 to 28 pigs with an equal distribution of barrows and gilts. Pigs were randomly allotted and blocked to 1 of 6 dietary treatments with 7 pens per treatment. Pigs were fed corn-soybean meal-based experimental diets (Table 1) in meal form. The treatments were arranged in a 2 × 3 factorial with main effects of crude glycerol (0, 2.5, or 5%) and added fat (0 or 6%). A single lot of crude glycerol was stored and used in the trial. All experimental diets were balanced to maintain a constant standardized ileal digestible lysine:ME ratio. Pigs and feeders were weighed on d 0, 14, and 28 to determine the response criteria of ADG, ADFI, and F/G.

Data were analyzed as a randomized complete block design by using the PROC MIXED procedure of SAS with pen as the experimental unit. The main effects and interaction between fat and glycerol were tested. Linear and quadratic polynomial contrasts were used to determine the effects of increasing added glycerol.

Results

Overall (d 0 to 28), there was a fat × glycerol interaction ($P < 0.04$) for ADFI (Table 2). When 5% glycerol was added to diets without added fat, ADFI decreased; however, ADFI did not change when glycerol was added to diets containing 6% added fat.

Pigs fed diets with added fat had greater ($P < 0.01$) ADG than pigs fed diets with no added fat. Adding fat to the diet improved ($P < 0.01$) F/G because pigs fed added fat converted feed more efficiently than pigs fed diets with no added fat.

Increasing glycerol decreased ADG (linear, $P < 0.02$) and ADFI (linear, $P < 0.04$) and tended (linear, $P < 0.08$) to worsen F/G, a result of the negative effect of adding glycerol to diets without fat.

Discussion

Adding fat to diets of these finishing pigs resulted in significant improvement in ADG and F/G. Adding 6% fat to the diet increased ADG 9.7% and improved F/G 9.3%. Compared with previous research trials in this facility, the growth response was greater than expected for this weight range; however, the response in F/G was similar to previous trials.

Previous research at KSU has shown increases in ADG and ADFI and slight improvement in F/G when feeding glycerol to nursery pigs. Our trial was designed to test performance in finishing pigs. Because crude glycerol has been reported to have energy content similar to corn, we did not expect that adding up to 5% glycerol to the diet would influence growth performance. We speculated that any negative effects, if observed, may be due to poor diet flowability when 5% glycerol was added to diets containing 6% fat. Because adding glycerol to diets containing 6% fat did not influence growth performance, flowability does not appear to be a major problem. Conversely, adding glycerol to diets without added fat resulted in poorer ADFI, ADG, and F/G.

The negative effect of glycerol on feed intake in diets without added fat was surprising. Glycerol from this same lot was used in the previous nursery trial conducted at KSU. It is

possible that storing this lot of glycerol in the feed mill for 3 mo (over the summer) may have resulted in decreased stability or oxidation of the glycerol thus decreasing palatability. Further research is planned at KSU to investigate this possibility.

Table 1. Diet composition (as-fed basis)

	0% added fat			6% added fat		
Item, %	0% glycerol	2.50% glycerol	5% glycerol	0% glycerol	2.50% glycerol	5% glycerol
Corn	82.84	80.14	77.43	74.37	71.66	68.96
Soybean meal, 46.5% CP	15.24	15.44	15.64	17.71	17.91	18.11
Glycerol	---	2.50	5.00	---	2.50	5.00
Choice white grease	---	---	---	6.00	6.00	6.00
Monocalcium P, 21% P	0.45	0.45	0.45	0.50	0.50	0.50
Limestone	0.85	0.85	0.85	0.80	0.80	0.80
Salt	0.35	0.35	0.35	0.35	0.35	0.35
L-lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
Vitamin premix with phytase[1]	0.06	0.06	0.06	0.06	0.06	0.06
Trace mineral premix	0.07	0.07	0.07	0.07	0.07	0.07
Total	100	100	100	100	100	100
Calculated analysis						
Total lysine, %	0.79	0.79	0.79	0.85	0.85	0.85
SID[2] Lysine:ME, g/Mcal	2.09	2.09	2.09	2.07	2.07	2.07
Standardized ileal amino acids, %						
Lysine	0.70	0.70	0.70	0.75	0.75	0.75
Isoleucine:lysine	0.71	0.70	0.70	0.70	0.69	0.69
Leucine:lysine	1.79	1.76	1.74	1.67	1.65	1.62
Methionine:lysine	0.31	0.31	0.31	0.3	0.29	0.29
Met & Cys:lysine	0.65	0.64	0.63	0.61	0.6	0.59
Threonine:lysine	0.63	0.63	0.62	0.62	0.61	0.61
Tryptophan:lysine	0.19	0.19	0.19	0.19	0.19	0.19
Valine:lysine	0.84	0.83	0.82	0.81	0.8	0.79
ME, kcal/lb	1,522	1,522	1,522	1,645	1,645	1,645
Protein, %	14.3	14.1	14.0	14.7	14.6	14.4
Ca, %	0.48	0.48	0.48	0.48	0.48	0.48
P, %	0.43	0.43	0.42	0.44	0.43	0.42
Available P, %[3]	0.22	0.22	0.22	0.23	0.23	0.23

[1] Provided per pound of diet: 170 phytase unit (FTU) of phytase.
[2] SID = Standardized ileal digestible.
[3] Includes expected P release of .07% from added phytase.

Table 2. Effects of glycerol on grow-finish pig performance[1]

	0% added fat			6% added fat				Contrasts, $P <$				
											Glycerol	
Item	0% glycerol	2.50% glycerol	5% glycerol	0% glycerol	2.50% glycerol	5% glycerol	SE	Fat × Glycerol	Fat	Glycerol	Linear	Quadratic
d 0 to 28												
Initial wt, lb	171.2	171.5	171.2	171.3	171.5	171.3	2.31	1.00	0.96	0.99	1.00	0.90
ADG, lb	1.85	1.78	1.67	2.03	1.98	2.00	0.04	0.14	0.01	0.05	0.02	0.82
ADFI, lb	6.38	6.44	6.03	6.33	6.21	6.29	0.09	0.04	0.86	0.08	0.04	0.38
F/G	3.45	3.63	3.63	3.13	3.13	3.14	0.06	0.28	0.01	0.14	0.08	0.35

[1] A total of 1,093 pigs (initially 171.3 lb) were used in a 28-d experiment. Each pen contained 24 to 28 pigs with an equal distribution of barrows and gilts. There were 7 pens (replications) per treatment.