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Abstract

Expansion of the renewable fuels industries has increased availability of by-products that are well suited for use as cattle feed. Glycerin is among the principal by-products of biodiesel production, comprising approximately 10% (by weight) of the soybean oil that is used to manufacture soy-based diesel fuel. Our previous research evaluated effects of including between 0% and 16% glycerin in flaked-corn finishing diets and revealed that optimal growth performance was achieved with 2% glycerin addition. Our laboratory experiments have suggested that even lower levels of glycerin may be effective at stimulating digestion. Therefore, the objective of this study was to evaluate effects of low levels of glycerin in the diet on performance and carcass characteristics of finishing cattle. Furthermore, because distillers grains and other by-products are increasingly common in feedlot rations, we opted to evaluate glycerin in corn-based finishing diets as well as in diets that consisted of a combination of corn grain, distillers grains, and soybean hulls.

Keywords

Cattlemen's Day, 2010; Kansas Agricultural Experiment Station contribution; no. 10-170-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1029; Beef Cattle Research, 2010 is known as Cattlemen's Day, 2010; Beef; Crude glycerin; Performance; Carcass characteristics; Feedlot; Heifers

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Effects of Feeding Low Levels of Crude Glycerin With or Without Other By-Products on Performance and Carcass Characteristics of Feedlot Heifers[1]

C.J. Schneider, G.L. Parsons, K.A. Miller, L.K. Thompson, and J.S. Drouillard

Introduction

Expansion of the renewable fuels industries has increased availability of by-products that are well suited for use as cattle feed. Glycerin is among the principal by-products of biodiesel production, comprising approximately 10% (by weight) of the soybean oil that is used to manufacture soy-based diesel fuel. Our previous research evaluated effects of including between 0% and 16% glycerin in flaked-corn finishing diets and revealed that optimal growth performance was achieved with 2% glycerin addition. Our laboratory experiments have suggested that even lower levels of glycerin may be effective at stimulating digestion. Therefore, the objective of this study was to evaluate effects of low levels of glycerin in the diet on performance and carcass characteristics of finishing cattle. Furthermore, because distillers grains and other by-products are increasingly common in feedlot rations, we opted to evaluate glycerin in corn-based finishing diets as well as in diets that consisted of a combination of corn grain, distillers grains, and soybean hulls.

Experimental Procedures

Crossbred heifers (n = 295; 941 ± 19.5 lb) were fed grain-based finishing diets containing 0%, 0.5%, or 2% crude glycerin or diets containing by-products with 0% or 2% crude glycerin. In by-product-based finishing diets, 25% soybean hulls and 15% wet distillers grains replaced corn and soybean meal. Diets primarily consisted of dry-rolled corn for the first 37 days of the feeding period and then gradually transitioned to diets based on steam-flaked corn. All diets contained 3% alfalfa hay and 6% corn silage and provided 300 mg Rumensin (Elanco Animal Health, Greenfield, IN), 90 mg Tylan (Elanco Animal Health), and 0.5 mg MGA (Pfizer Animal Health, New York, NY) per heifer daily. Heifers also were fed Zilmax (Intervet/Schering-Plough Animal Health, Millsboro, DE) at 7.56 g/ton for 21 days before harvest.

Incoming cattle were allowed free access to ground alfalfa hay and were processed within 24 hours of arrival. During processing, heifers were identified with an individual ear tag, individually weighed, implanted with Revalor 200 (Intervet/Schering-Plough), vaccinated with Bovi-Shield-IV and Fortress-7 (Pfizer Animal Health), injected with Micotil (Elanco Animal Health), and drenched with Safe-Guard (Intervet/Schering-Plough) for internal parasites. Four weeks after initial processing, cattle were revaccinated with Bovi-Shield-IV. Prior to initiation of finishing treatments, cattle were fed a series of step-up rations to gradually adapt them to their final finishing rations (Table 1).

[1] Funding provided by the Kansas Soybean Commission Checkoff.

Cattle were stratified by body weight and randomly assigned (within strata) to 40 pens containing seven to eight animals per pen; there were eight pens per treatment. Pens were partially covered and had solid concrete surfaces (392 ft^2). Feed bunks provided no less than 12 linear in. of bunk space per animal, and fence line water fountains were shared between two adjacent feedlot pens.

Weight of each pen of heifers was determined at the beginning of the experiment and immediately prior to slaughter. After 89 days on feed, cattle were transported to a commercial abattoir in Holcomb, KS, and harvested. Carcass weights and incidence of liver abscesses were recorded on the day of harvest, and USDA quality grade; USDA yield grade; marbling; 12th rib fat thickness; ribeye area; and kidney, pelvic, and heart fat were recorded after a 48-hour chilling period.

Results and Discussion

Addition of glycerin to grain-based diets caused a linear ($P=0.04$) decrease in dry matter intake (Table 2). However, there were no differences in dry matter intake between the 0.5% and 2% glycerin levels in grain-based diets. Feeding both 0.5% and 2% glycerin in grain-based diets tended to cause a 3.5% decrease (0.5%, $P=0.06$; 2%, $P=0.07$) in daily dry matter intake compared with the control steam-flaked corn diet. Similar glycerin effects on dry matter intake were not observed when glycerin was fed in a by-product diet (Table 2). Feeding 2% glycerin in a by-product diet increase ($P<0.01$) daily dry matter intake 11.1% compared with feeding 2% glycerin in a grain-based diet. The addition of by-products without glycerin increased ($P<0.01$) daily dry matter intake by 5.3% compared with the control steam-flaked corn diet. Collectively, the addition of by-products, with or without glycerin, increased ($P<0.01$) dry matter intake compared with grain-based diets (Table 2). The carcass-adjusted feed-to-gain ratio also was poorer ($P<0.01$) as a result of adding by-products to the diet. There were no differences ($P>0.2$) among treatments with respect to average daily gain, feed-to-gain ratio, and final body weight.

Glycerin added to grain-based diets had a linear tendency ($P=0.058$ for overall F test and $P=0.03$ for contrast) to decrease the percentage of carcasses that graded USDA Choice or higher (Table 2). Consequently, glycerin fed in grain-based diets caused a linear increase ($P=0.02$) in the percentage of carcasses that graded USDA Select. Similarly, the addition of by-products had a tendency ($P=0.058$ for overall F test and $P=0.02$ for contrast) to decrease the percentage of carcasses that graded USDA Choice or higher and increase ($P=0.02$) the percentage of carcasses that graded USDA Select (Table 2). There were no differences ($P>0.3$) among treatments in hot carcass weight; dressed yield; loin muscle area; 12th rib fat thickness; marbling score; USDA yield grade; liver abscess prevalence; or kidney, pelvic, and heart fat.

Implications

Adding low levels of glycerin reduced dry matter intake in grain-based diets but had no effect on dry matter intake in diets containing by-products. Unlike previous studies, adding glycerin to the diet did not improve performance.

Table 1. Composition of steam-flaked corn-based finishing diets containing low levels of crude glycerin and diets containing by-products with or without crude glycerin fed to yearling heifers

	Grain-based diets			By-product-based diets	
Ingredients, % dry matter	0% Glycerin	0.5% Glycerin	2% Glycerin	0% Glycerin	2% Glycerin
Steam-flaked corn	80.7	80.1	78.3	45.6	44.2
Soybean hulls	---	---		25.0	25.0
Wet distillers grains	---	---		15.0	15.0
Corn silage	6.0	6.0	6.0	6.0	6.0
Soybean meal	4.4	4.5	4.8	---	0.4
Alfalfa hay	3.0	3.0	3.0	3.0	3.0
Crude glycerin	---	0.5	2.0	---	2.0
Supplement[1]	5.9	5.9	5.9	4.4	4.4
Analyzed composition, %					
Dry matter	76.1	76.2	76.3	64.6	64.7
Neutral detergent fiber	13.5	13.4	13.3	29.8	29.6
Crude protein	14.4	14.4	14.4	14.1	14.1
Calcium	0.7	0.7	0.7	0.9	0.9
Phosphorus	0.3	0.3	0.3	0.4	0.4
Potassium	0.8	0.8	0.8	0.9	0.9

[1] Formulated to provide 300 mg/day Rumensin; 90 mg/day Tylan; 1,000 IU/lb vitamin A; 10 IU/lb vitamin E; 10 ppm copper; 60 ppm zinc; 60 ppm manganese; 0.5 ppm iodine; 0.25 ppm selenium; and 0.15 ppm cobalt. Zilmax was fed for 21days before harvest at the rate of 7.56 g/ton of diet dry matter followed by a 3-day withdrawal period.

Table 2. Performance and carcass characteristics of yearling heifers fed finishing diets based on steam-flaked corn containing 0%, 0.5%, or 2% glycerin or diets containing by-products with 0% or 2% glycerin

	Grain-based diets			By-product-based diets			Contrast P-values[1]	
Item	0% Glycerin	0.5% Glycerin	2% Glycerin	0% Glycerin	2% Glycerin	SEM	Glycerin Effect	By-product Effect
Initial weight, lb	942	941	942	943	939	19.51		
Final weight[2], lb	1240	1222	1214	1215	1220	18.80		
Dry matter intake, lb/day	19.5[a]	18.7[a]	18.8[a]	20.5[b]	20.9[b]	0.40		<0.01
Average daily gain, lb/day	2.95	2.7	2.56	2.56	2.87	0.15		
Feed:Gain	6.58	6.92	7.30	7.16	7.89	0.38		
Carcass-adjusted feed:gain	5.81	5.92	6.73	6.73	6.56	0.01		<0.01
Hot carcass weight, lb	787	776	771	772	775	11.94		
Dressing percentage	65.4	65.7	65.9	64.5	66.1	0.01		
Ribeye area, sq in.	14.3	14.2	13.9	13.8	14.1	0.21		
12th rib fat thickness, in.	0.5	0.5	0.5	0.55	0.47	0.03		
Kidney, pelvic, and heart fat	2.1	2.0	2.1	2.0	2.1	0.08		
Liver abscess prevalence, %	3.3	1.8	3.3	3.3	5.4	2.52		
Marbling[3]	Sm 50	Sm 30	Sm 20	Sm 30	Sm 30	13.12		
USDA yield grade	2.1	2.0	2.1	2.2	2.1	0.10		
USDA quality grade, %								
Premium Choice	26.1	16.4	15.2	18.8	20.3	0.74		
Choice or greater	80	65	66	60	61	0.06		0.02
Select	12	26	27	34	32	0.04		0.01
Standard	8	9	7	6	7	0.44		

Within a row, means without common superscripts are different (P<0.05).
[1] Contrasts protected by an overall F-test (P<0.10).
[2] Final body weight was calculated as hot carcass weight divided by a common dressing percentage of 63.5%.
[3] Sm, Small amount of marbling as determined by USDA grader.